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LAND TENURE.

OF the importance of agriculture to the tropics there can be little doubt for, although mineral wealth may attract for a time, prosperity must eventually rest upon permanent cultivation of the soil and it is mainly for the purpose of securing tropical agricultural products that Europeans have impinged upon the tropics. The mode of the proprietorship of land therefore becomes of prime importance in determining the nature of the development of the country. Ownership of land in the tropics was deemed to be vested in the hands of some chief or king who possessed the power of allocating any vacant land according to his pleasure, but who was not justified in dispossessing anyone already cultivating the land. In savage warfare the conqueror took possession of the land of the vanquished and was, moreover, considered to have the right of disposing of the lives and belongings of the conquered people. In civilised warfare, however, while the victor becomes the ultimate owner of the land, he is not considered to possess the right of confiscating private right in land.

In this manner Great Britain, as the conquering nation, obtained control over huge areas of tropical lands and upon the manner in which she exercised this right depended the future prosperity of the inhabitants. Broadly speaking there are two types of land, one whose climatic conditions render it suitable only for occupation by the indigenous coloured population, and where the white man is usually a "bird of passage," and the other, land which is equally suited to colonisation by the white and coloured man. The first type is often occupied by a fairly dense native population and the problem of the adjustment of the requirements of the white and coloured man does not arise in any acute form, since permanent occupation by the white man is impossible, and here the most urgent problem is the adjustment of differences between the natives. West Africa and parts of India are typical of the first kind. In the second type a sparse native population is frequently encountered and the main problem is to attract sufficient capital and energy to enable the potential wealth of the country to be exploited. Here the inherent difficulties of the situation are much more appreciable and urgent, since it requires a nice judgment to balance the possible and future requirements of the two types of races, especially in view of the fact that future developments are a matter of mere conjecture. Kenya, Rhodesia and South Africa are typical of such countries.

In these countries two general lines of development are possible, one dependent upon the large and capitalistic plantation, typical of the European, and the other the small holding typical of native peasant culture. In the early days of development the main difficulty is to attract sufficient capital to enable the country to be opened up, and the only possible form of agriculture to be adopted is an extensive one, in contrast to the intensive system. An extensive system requires the expenditure of a considerable amount of capital, and capital will not be attracted unless some security is given that the investment may be considered a reasonably safe one. The most satisfactory security from the point of view of the investor, and the easiest means of attracting capital by the authorities, is permanent possession

of the land, since it gives the investor a tangible and immovable asset and costs the authorities nothing to give. Thus far the system seems eminently satisfactory for no existing interests are materially affected, the country succeeds in attracting capital and the investor receives his necessary security. In this way considerable tracts of land passed into the hands of individuals or companies ; one such company owning 350,000 acres and the East African Syndicate and the British Central African Company 320,000 acres. There is no doubt that such companies were able, by their rapid mobilisation of capital, to effect more rapid improvements than would have been possible by the Home Government, where each demand for capital has to run the guantlet of the House of Commons.

The disposal of huge areas of land by this method, however, laid the foundation of future difficulties, which arose when the growth of population began to exert pressure upon the available land. This increase of population may arise either through a natural increase in the indigenous population, or through immigration. The first cause is one of slow development but when supplemented by the second may lead to a crisis comparatively rapidly. The trouble is aggravated and the crisis hastened when land is acquired, not primarily for the purpose of cultivation, but mainly with the object of reaping the " incremented value " as the growth of an organised economic and political system around the land enhances its value.

Under such a system some of the indigenous population become divorced from the soil and there arises a permanent wage-earning class dependent for its livelihood upon the ability to market its labour. It is this system which has led to the rise of the great planting industries which have made tropical and sub-tropical staples such as sugar, tea, coffee, cocoa, rubber, &c., available for the inhabitants of temperate countries, and which has enabled the development of the tropics to be accomplished by the construction of roads, railways, harbours, steamships, &c.

This system, however, is not an ideal one since it smoothes the path of the speculator, the bane of any tropical country ; affords too little scope for the expansion of the indigenous races, and prevents the authorities and other bodies from sharing in the " incremented value." On the other hand the country which is composed of small peasant proprietors is likely to progress but slowly, owing to the lack of initiative. The system typical of the small landed proprietor is one in which each small community grows all that it needs and consumes all that it grows. Rarely, except under European guidance and assistance is there any surplus for export and seldom any adequate system of transport for exporting, and commerce can not be built up unless there is a continuous surplus. Particularly is this the case where the law provides, as in India and Ceylon, under both Mahommedan and Hindu law, that upon the decease of the father the land is divided among the members of the family. Sooner or later under this system fragmentation proceeds to such an extent that there arises the uneconomic holding, and nothing is more characteristic of the native than the tenacity with which he clings to his small holding of land long after it has ceased to be adequate for his support.

Yet the creation of a class of prosperous small landed proprietors adds much to the strength and solidarity of a country. Such a system, however, involves not merely the operation of a sound land tenure system but also the means for the encouragement of scientific agriculture, by the establishment of adequate Departments of Agriculture, the distribution of seeds, &c., the creation of adequate means of transport, the provision of credit facilities, and assistance in marketing. It has been proved by the wonderful growth of the cocoa industry in the Gold Coast that the natives can, under favourable circumstances, and with expert guidance build up a prosperous exporting industry, and upon a firmer basis than the large plantation industries, since the native industry is self-supporting with regard to labour and is a more natural growth.

In the past too little attention has been devoted to land tenure as a comprehensive economic problem and it is to be hoped that with the growing recognition of the importance of the tropics this highly important problem will receive due consideration. Huge areas of commercially undeveloped land still exist in the tropics and a wise land tenure policy will do much to facilitate their exploitation upon a sound agricultural basis. Both the large capitalistic plantations and the small native holdings have their advantages and disadvantages and each tropical country requires a wise adjustment of both systems so that the optimum permanent benefit is achieved, both for the individual country and the world as a whole.

THE increase in the number of subscriptions to the Journal has recently exceeded even the most sanguinary expectations. More *new* subscriptions, as distinct from renewals, were received during December than in any previous month. The Journal has been widely quoted in all the more important tropical and scientific publications, both British and foreign, and the Editor desires to take the opportunity of thanking all concerned. Readers desiring to complete their files are requested to apply as early as possible for back numbers as the supplies are rapidly being exhausted.

The Editor will be pleased to send gratuitous specimen copies post free to members of agricultural societies, or to any other individual interested in tropical development, on application to him at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

HOOKWORM DISEASE.

(Ankylostomiasis)

C. L. WITHYCOMBE, Ph.D., D.I.C.

THE progressive agriculturist has long realised that success or failure in his vocation is not merely a matter of pure agriculture, to be represented in terms of crop production: there are other and more subtle considerations which would sometimes seem even to outweigh in importance the more apparent essential. Increased stress of competition has driven the agriculturist, like all other business men, to investigate every possible means of increasing efficiency, and the measure of his prosperity is largely determined by the success which he achieves in this direction.

It is from this aspect that the recent lectures given at the College by Dr. W. C. Hausheer upon Ankylostomiasis form a very necessary part of the training of any prospective tropical planter or administrator. The eradication of hookworm disease is not the concern of medical men alone, it is vital to the interests of all employers of labour in the tropics. For ten years past in Trinidad the Rockefeller Ankylostomiasis Commission has pursued its philanthropic work among the labouring classes of the island and after the departure in December of Dr. Hausheer the Commission's splendid work will be carried on by local administration. It is the duty of all, both to their fellow men and to themselves, to see that everything in their power is done to facilitate the continuation of this most valuable work so generously inaugurated by the Rockefeller Foundation.

Hookworm disease is almost entirely confined to warm climates and its occurrence in temperate countries is possible only in mines and similar places where the temperature is unduly equable and warm. The disease, which is also known as tropical anaemia, miner's anaemia, uncinariasis, &c., is due to the presence in the intestine of small parasitic worms, each little more than half an inch in length and in thickness about that of a pin.

In all probability the disease has existed from the earliest times. A recently discovered Egyptian papyrus suggests that it was known to the ancients, and it has long been referred to as Egyptian chlorosis, although the actual worm responsible for the disease symptoms was only brought to light in 1838. The complete pathology of the disease was not thoroughly understood until the outbreak of ankylostomiasis which occurred among the workmen in the St. Gothard tunnel in 1880. Styles, in 1902, shewed that the worm prevalent in the New World was a form distinct from that of the Old World and he named it *Necator americanus*, whereas the worm occurring in Africa and the Old World was known to science as *Ankylostoma duodenale*.

The results of enquiries instituted by the Rockefeller International Health Commission have shewn that ankylostomiasis is the most widespread disease in the world, with the possible exception of malaria. It causes more misery, invalidism and industrial inefficiency than any other disease, and is responsible for the stunting of intellect and growth. By rendering the victim unfit for work, it often drives him to dishonest means of procuring a subsistence.

Before discovery of the worms the diseased condition to which they gave rise was entirely misunderstood. John Hunter considered it a mental ailment. Negro slaves were supposed to die from home sickness. In America it was called the lazy disease; a most unjust condemnation of the poor sufferers who were enduring not only the pain and discomfort of the disease but also privation from inability to work for their living. The employers inevitably suffered also by the incapacitation and inefficiency of their labourers, to procure whom they had gone to some trouble and expense, only to see them spend much of their time in hospital instead of at work, not to mention the losses from death. In Porto Rico it is estimated that thirty per cent. of the deaths in the island are due to this disease. Of the entire population of the tropics it is considered that sixty to ninety per cent. are infected with hookworm, and in Egypt, Ceylon, and St. Lucia absolutely the whole of the agricultural population. Reduction in efficiency is not the only evil effect of the disease; the presence of worms is a most dangerous complication of all other diseases which may be acquired, and, be it added, the hookworm sufferer is so lowered in vitality as to fall an easy prey to all such diseases.

Withal the cure is so simple and the preventive measures so obvious and inexpensive that it is possible to restore vast numbers of chronic invalids to healthy, happy, and self-supporting existence. This the Ankylostomiasis Commission is constantly striving to effect, and with most marked success.

Here, in the West Indies, are found both species of hookworms, the Old World *Ankylostoma* having probably been imported by East Indian and Chinese immigrants and the New World *Necator* by African slaves. *Necator* is the more common locally, but the geographical distribution of species is ill-defined. *Necator* is also known to exist in the pigmies of Central Africa, in the inhabitants of Ceylon and Malaya, and also in gorillas. Whichever species of worm produces the disease, the symptoms are similar, so that specific identity is not a matter of great importance, especially in view of the fact that both forms are amenable to the same treatment.

The mature worms are to be found most abundantly in the small intestine. Here they attach themselves by means of their hook teeth and feed on the living epithelium and blood which is freed from the capillaries supplying the intestine wall. Eggs, frequently to the number of nine thousand daily, are laid by each female in the intestinal canal. These are ellipsoidal in shape, about ·06 mm long, and are invested with a thin but resistant coat. They cannot hatch within the body of man but pass out with the faeces.

Microscopic examination will reveal the presence of these eggs in the stool of any infected person, and the number of eggs present per unit amount of stool gives a good index of the number of worms present in the intestine, since the distribution of eggs is very even.

Under favourable conditions of temperature, moisture, &c., the eggs will hatch, but if they are deposited in places where conditions are unsuitable, further development is arrested. A temperature of between 78° and 86° F., (25°-30° C.) appears to be best suited to the development of the egg, and with such a temperature, all else being favourable, the eggs hatch in from twenty-four to forty-eight hours. The eggs also require adequate moisture, but they do not live long if submerged in water.

From the egg there issues a minute larval worm about a quarter of a millimetre in length. This feeds on faecal matter and grows to nearly double its original size. It then moults and enters upon a second stage. After a further short period another moult occurs and the larva is now ready to infect man. It was once thought that only the third stage larva was capable of entering upon the life cycle in man, but recent work has suggested the possibility of earlier stage larvae being also infective. However this may be, it is important to note that it is the larval stage alone which is the infective one. Contact with the eggs is attendant with no danger whatever.

The third stage larva may live for from six to twelve months in water. It neither takes food nor requires any, as sufficient food reserve is stored within its own body. When the larva comes into contact with the human skin, usually that of the unprotected foot, it at once makes its way through the epidermis, either by way of a pore or a small crack in the skin, and eventually it enters the blood stream. With the blood it may travel to the lungs, thence to the air passages, trachea and larynx, until, passing down the oesophagus, the stomach and intestine are reached. The path varies in detail. Some worms may possibly enter the stomach directly with infected food. Many, passing by way of the lymphatic system, which is a common route, may be retained by the lymphatic glands and perish. It has been stated by Looss that a stray larva at times can wander for five years within the body.

Penetration of the skin by the larva may occasion some reddening and irritation at the affected point, which is followed in a few days by a transitory swelling. This condition is commonly known as " ground itch " &c., and labourers who are in the habit of working barefooted are peculiarly subject to it.

The larva moults for a third time about four or five days after reaching the intestine. It now fastens itself to the gut wall, and in from four to six days grows to between three and five millimetres in length, when a fourth moult takes place. Eight days later the worm is mature, and, a few days after pairing, egg-laying commences. The eggs may usually be detected in human faeces four to five weeks after the date of infection.

The adult worms, attached to the intestinal mucosa, are voracious feeders and often move from one bleeding spot to another, thus doing considerable damage, and giving rise, when numerous, to the group of symptoms known as hookworm disease.

Treatment is simple, but none the less calls for proper supervision, since all the drugs commonly employed as anthelmintics, while especially poisonous to the worms, are not without some effect upon the patient. Mass treatment of suspected cases, without previous examination, is not to be recommended, although it is not infrequently practised. The small element of risk should be sufficient to make one hesitate before submitting any patient to treatment without having previously assured oneself that the same is necessary.

Three drugs are commonly resorted to :

1. Thymol.
2. Oil of Chenopodium.
3. Carbon tetrachloride.

Of these, carbon tetrachloride is fast gaining in favour, on account of its cheapness and efficacy, while in proper hands it is probably quite as safe as either of the first two above-mentioned.

The first step in the prevention of hookworm disease lies in the elimination of centres of infection, and therefore it is obvious that curative measures must occupy a prominent place in any campaign for eradication. With the elimination of sources of infection much of the ground can be cleared and it then remains to enforce strict sanitation, especially in the provision and compulsory use of proper latrines. It need hardly be added that further efforts should be directed towards emphasizing the desirability of wearing boots. This implies, firstly, that the labourer is in a position to purchase the same, and, secondly, that when they are in his possession he will be willing to wear them continuously. Neither premise may be tenable, in which case the surest means of effecting the purpose is by educational methods. The inefficient hookworm sufferer is the least likely to be able to afford the expense of boots, but unless he can be initiated into the habit of wearing them things will pass from bad to worse.

As has been said, hookworm disease manifests itself in a very definite group of symptoms, which could be subdivided and dealt with at length, but as far as the present note is concerned it need only be mentioned that in addition to the digestive disorders and anaemia which produce the characteristic external pictures, the hookworm condition is also associated with serious upset of the nervous system. Mental alertness is distinctly reduced, there is a distaste for work, a general indifference and listlessness, together with a facial expression which bears out the mental state.

In children the mental retardation of hookworm sufferers is most marked and this aspect has received serious attention in the Queensland schools. Waite and Neilson have published the

results of comparative studies upon three hundred and forty school children to whom they applied the Binet-Simon and Porteus intelligence tests.

The children were divided by these investigators into three groups, as follows :

Group 1. Those not found to be infested—hookworm free.
Group 2. Lightly infested cases.
Group 3. Heavily infested cases.

Mental retardation in Group 1, the hookworm free, was found to average 3·9 months. Such a figure can easily be accounted for from a variety of causes other than ankylostomiasis.

The Binet test gave :

	Retardation.
Group 1, uninfested	3·9 months.
Group 2, lightly infested	9·3 months.
Group 3, heavily infested	23·4 months.

Results by the Porteus method were similar :

	Retardation.
Group 1, uninfested	2·8 months.
Group 2, lightly infested	4·9 months.
Group 3, heavily infested	16·6 months.

Hence it is clear that measurable mental sluggishness is produced by hookworm disease and this retards development proportionally to the magnitude of infestation. Similar results have been reported by Strong in his N. Carolina studies. Is it to be wondered at that many tropical schools find it difficult to obtain results comparable with those attainable in hookworm-free countries, and is the teacher to be blamed for his inability to teach successfully when the human material with which he has to work is placed under initial disability ? Hookworm disease is a constant menace to the progress of education and civilisation in the tropics.

The planter is more immediately affected by the pernicious influence of ankylostomiasis upon the efficiency of his labourers and figures upon this side of the question are not difficult to obtain. Dr. Hausheer in one of his lectures mentioned a marked example from his own experience which I cannot do better than quote in detail.

Observations were made upon three contiguous coffee estates in Dutch Guiana on the road from Paramaribo to the sea. The conditions obtaining in all three were almost identical. On Estate No. 1 the number of hookworm cases was 142 ; upon Estate No. 2, 88 ; and on No. 3, 61. All three estates had an average infestation of approximately ninety per cent. The labourers on No. 1, had never been treated. On No. 2, for a period of several years all labourers were given treatment twice a year whether they required it or not. Estate No. 3 had had treatment off and on, but not as regular routine.

In 1921 all three estates were treated until practically all infestation was removed. A group of individuals from each estate was then taken, who, for one year previous to treatment, had been doing the same task work at the same rate of pay and who were still continuing with this task work. Their daily average pay was worked out over a period of twelve months previous to treatment, and then, after a further period of six months after cure, the daily average of these same individuals was again calculated. The groups were comparatively large, and everyone whose task and pay had not been altered was included, so that the patients were not selected cases.

On Estate No. 1, average increase of pay per man was 38 per cent.

On Estate No. 2, average increase of pay per man was 2 per cent. (this estate treated labourers twice a year).

On Estate No. 3, average increase of pay per man was 15 per cent. (this estate had had some treatment in past, but quite erratically).

From the above it is seen that the increase in efficiency or earning capacity upon two of the three estates varied from 15 to 38 per cent. These findings correspond with those of Kiebler, obtained in the same country in 1917.

Schapiro, reporting upon the hookworm campaign in Costa Rica in 1919, states that earning capacity on Rodeo Estate increased by 14·6 per cent., after treatment, and on Aquiares by 27 per cent. The wages on Rodeo remained the same, while those on Aquiares were reduced by 15 per cent., during the interval between the periods compared. On the latter estate there was therefore in reality an increase of 42 per cent. in earning capacity if the 15 per cent. reduction in pay be taken into account.

" Larger areas have been cultivated and greater crops obtained since the workers were treated and cured of hookworm disease. On Aquiares,———, the acreage under coffee cultivation was increased 33 per cent. This has been accomplished without additional labour, and with a lower unit cost for cultivation."

The most recent work on increased efficiency of labour due to hookworm eradication was published a few months ago in the *Bulletin of the Royal Society of Tropical Medicine*. The investigation was carried out by the medical officer of the Demerara Bauxite Company in British Guiana. He says that the total expense incurred for hookworm treatment, by means of carbon tetrachloride covering 1,354 treatments amounted to $13.44 or one cent per treatment. An enclosed letter from the manager of the firm states that miners on opening the mine, on January 13th, 1923, were loading 3·6 tons of ore per man per ten hour day. At the end of eight months training the amount increased to 5 tons per man per ten hour day. These miners were treated for hookworm in September, 1923. No change in the number of tons mined per man occurred in September or October, but in November it went up to 5·1 tons per man, in December to 5·15, in January to 5·6, and in February to date 6·76 tons per man per ten hour day, *i.e.* at the time of writing the increase per man

was 1·76 tons. These figures are to be regarded as conservative because in this particular mine an ordinary physical examination is given to every man before he is employed. If a person showed clinical signs of ankylostomiasis he was either not employed or first treated. Therefore those included in this work were only moderately infested cases.

One need expatiate no further upon the enormous and far reaching effects of ankylostomiasis upon the industrial efficiency of any tropical country or upon the great benefits which accrue from the suppression of the disease. As was stated earlier, this is not a medical problem, it is a sociological one, and it is the public duty of all to co-operate in the eradication of one of the most insidious inhibitors of man's progress in the tropics. The remedy is in our own hands : who is to blame if we neglect it ?

A COCOA PLANTERS' ASSOCIATION.

C. Y. Shephard, B.Sc. (Econ.)

The world production of cocoa has increased from 234,000 tons in 1912 to 456,000 in 1923, representing an increase of nearly 100 per cent. It is very satisfactory to observe that most of this development has occurred within the British Empire. As will be observed from the table below, the British Empire produced only 75,763 tons out of a total world production of 234,500 in 1912, but in 1923 the British Empire was responsible for no less than 274,499 tons out of 456,000 tons, *i.e.*, the proportion of the world's cocoa coming from the British Empire had increased from approximately one-third to three-fifths.

Production of Cocoa (net Exports).

	1912 *Metric tons.*	1921 *Metric tons.*	1923 *Metric tons.*
British Empire	75,768	204,520	274,499
Foreign Countries	158,732	186,480	181,501

The greatest growth in production has occurred in the Gold Coast where exports rose from 38,647 metric tons in 1912 to 194,128 metric tons in 1923. In Lagos exports increased from 3,390 metric tons in 1912 to about 31,000 metric tons (estimated) in 1923. In Trinidad exports increased from 18,528 metric tons in 1912 to 30,219 metric tons in 1923 (1).

Consumption too, has increased enormously, rising from 252,000 metric tons in 1912 to 431,000 metric tons in 1923. The greatest increase has taken place in the United States of America where imports increased from 64,698 metric tons in 1912 to 179,353 metric tons in 1923. The consumption in Great Britain increased from 28,044 metric tons to 30,600 metric tons during the same period.

It is worthy of note that the production of the Empire considerably exceeds the demand.

The last year has been a disastrous one from the producers' point of view for prices dropped to record low levels, reaching 8 cents (4d.) per lb. (spot) in New York for Trinidad mid-red and 3½*d.* per lb. (spot) for Accras, being in most cases less than the cost of production and marketing. Recently prices have risen rapidly until at the present time Trinidad cocoa fetches 17 cents (8½*d.*) per lb. and Accras 4½*d.* per lb.

Although the outlook is promising at the moment it is essential that provision should be made against another fall in price which will arise if production exceeds the demand at present prices. The remedy would appear to lie in a co-operative organisation of cocoa producers. Somewhat similar difficulties had to be faced in regard to the marketing of tea and rubber. In tea the difficulty was met by instituting a small levy on exports, the proceeds of which were devoted to propaganda work in possible markets. More recently tea planters began to reduce output by resorting to fine plucking with the result that tea is now in a very strong and healthy position. Similarly with rubber it was found that production was increasing so enormously compared with the increase in demand, at then existing prices, that prices dropped to unremunerative levels. The rubber producers of Malaya and Ceylon banded themselves together and induced the Government to introduce a system of restricted output, based upon the standard production, and largely as a result of this prices were materially improved. To-day, however, the production of newly planted areas, both inside and outside the areas of restricted production, is tending towards another period of large excess of production over consumption, but of the truth of the statement that a restricted output tends to raise prices there can be no doubt.

In the case of both tea and rubber, combination was comparatively easy as both crops are produced on a fairly large scale by large companies, and the task of organising was facilitated. Cocoa, however, is largely a small man's crop, and that, combined with the scattered geographical distribution of the crop, makes the task more difficult. On the other hand, as in the case of both tea and rubber, the bulk of the world's exportable surplus comes from within the British Empire and, in addition, a very large proportion, sufficient to determine the world's basic price for cocoa, comes from one area, the Gold Coast. It is gratifying to note that the Empire producers have already agreed upon the general principle of co-operation with a view to increasing consumption. An organisation combining all interests from the planter to the manufacturer is urgently required for the general purposes of

(1) It should be noted that production during 1912 was abnormally low, and an average of the three years immediately preceding would give an output of approximately 26,500 metric tons.

stimulating and increasing the demand for cocoa, compiling reliable statistics, co-operative marketing, improving the scientific knowledge of the cultivation and preparation of cocoa, and of devising some potential means of exercising control over production.

One of the most effective ways of extending the demand for cocoa is by intensive and extensive advertising. Manufacturers already spend considerable sums of money in advertising their particular products, but so far producers have made little effort to participate. Indeed it may be argued that producers have no interest in pushing the sales of any particular manufacturer but they have a very *real* interest in extending the demand for cocoa as a product and it is with this aspect that I am particularly concerned.

Certain producers maintain that an extension in the demand for cocoa can only arise at the expense of a diminished demand for tea and coffee. This belief becomes untenable when we realise that it implies that "saturation point" for tea, coffee, and cocoa has been reached. While an additional demand *may* result in a diminished demand for tea and coffee there is a tremendous scope for an increased consumption of cocoa without in any way affecting demand for tea and coffee. In fact the *per capita* consumption of all three may increase side by side. When we realise that the consumption of tea, coffee and cocoa in the heaviest consuming countries is still increasing, and when we further realise that consumption in many countries is ridiculously small and is capable of considerable extension, it becomes obvious that such a statement is founded upon a misconception of world movements. In the United States of America, for example, where approximately one-third of the world's output of cocoa is consumed, *per capita* consumption has increased from about 1·5 lb. in 1915 to 3·2 lb. in 1920. With its huge population and the continuation of "prohibition," considerable development can still be expected. The *per capita* consumption in the United Kingdom has risen from 2 lb. in 1915 to 2·5 lb. in 1922. "Saturation point" for cocoa in its use as a beverage has not yet been reached in any country and certainly not for the world as a whole. It is equally certain that in the other uses for cocoa "saturation point" has not yet been reached; witness the recent attempt to establish cocoa bread upon the market. With the merits of cocoa bread we need not at the moment concern ourselves, but as an illustration of the attempt to discover new uses for cocoa it is obvious that to succeed it must have considerable financial backing, sufficient indeed to carry on a comprehensive world-wide campaign. Sporadic local efforts, praiseworthy though they be, are likely to be of little permanent value. Surely it is not beyond the ingenuity of those interested in cocoa to discover further uses for cocoa and cocoa by-products. Herein lies a worthy object for the attentions of the combined cocoa producers.

A considerable sum of money is required to conduct a campaign calculated to bring success, and one of the first duties of any organisation uniting the various parties interested in cocoa would be to evolve a scheme for raising such funds. Manufacturers might be asked to contribute a certain small percentage of their turnover, while cocoa producers might make a voluntary levy, or persuade their Governments to introduce a small compulsory tax, on every cwt. of cocoa exported. The amount levied on each cwt. might be almost negligible but in the aggregate would amount to a very considerable sum. The sum thus secured might be administered by an elected body representative of all interests concerned for the general purposes previously indicated. The demand can be increased in two ways, namely, by (*a*) creating new markets and extending old ones and (*b*) by stimulating the use of cocoa in other directions. Much can be done to further both by means of advertisements, cinema films, illustrated lectures, pamphlets, recipes, competitions, distribution of samples, exhibitions, &c. Care should be taken to select areas likely to yield the best results and then a general campaign launched. This campaign should be extensive, in the sense that a wide area is covered, and intensive, in the sense that each area is thoroughly and continuously worked, since sporadic attempts are not likely to lead to definite results. The immediate results are likely to be disappointing and the campaign must be continued over a long period before appreciable results can be expected. It is for this purpose that a regular revenue must be forthcoming, raised either upon the lines I have suggested or by similar measures. No other body than an association of cocoa producers is likely to possess sufficient sums to carry on such an extensive campaign indefinitely.

Another feature should be the compilation of really reliable statistics regarding cocoa. The writer is of the opinion that the recent depression in prices was due, not so much to over-production as to the uncertainty regarding existing stocks. Large stocks which appeared to exist have melted into thin air and the market has resumed a more normal tone. Accurate information should be distributed to all members of the organisation so that they, and the public generally, would be kept "*au fait*" with current conditions. Much can be accomplished in the way of more efficient marketing if and when the various producers are organised into one body. At present the lack of co-ordination and guidance upon the general principles of marketing has left the individual producer at a great disadvantage in marketing his product, since it is impossible for each individual to gauge the effect of the fluctuations in the markets.

The organisation might consider it advisable to establish experiment stations, or to finance existing institutions, for the purpose of improving the scientific knowledge of cocoa, its cultivation, management, preparation, &c. Cocoa producers

are suffering to-day not so much from over-production as from a surfeit of inferior quantities of cocoa. It has been said that cocoa is a crop which requires very little cultivation and usually gets it. The cocoa situation might be materially improved if types of cocoa with peculiar qualities and choice flavours were evolved, much in the same way as certain types of tea always command a ready market and a highly remunerative price on account of their distinctive properties. There is not the slightest doubt that by improvements in the cultivation and the more scientific management of cocoa estates, costs of production could be considerably decreased, and some authorities even go so far as to assert that prices which have in the past proved disastrous to cocoa producers would, under improved methods, prove quite remunerative. The truth of this statement is supported by the fact that some producers on efficiently managed estates succeeded in securing a profit even with last year's low prices. It is important to remember that if the average cost of production can be decreased, in normal circumstances there would be an extension in the effective demand, which would make restriction of output unnecessary, and materially assist in propaganda work. During the present depression many potential consumers of cocoa have been prevented from making their demand effective on account of a high cost. Any results achieved should be made available for all members of the organisation or local agents.

On the other hand it should constantly be borne in mind that any measure calculated to increase demand for the purpose of enhancing price is not likely to be of permanent value unless producers are prepared to exercise some control over production. As soon as prices rise to highly remunerative levels individual cocoa producers, anxious to benefit to the full, immediately lay down new areas of cocoa trees with the result that when they come into bearing, the production, after deducting trees which meantime have ceased to bear, is materially increased, and unless demand has increased at an equal or a relatively faster rate prices inevitably fall. This has been abundantly realised in the case of tea where the beneficial aspects of extensive advertising were rendered futile by the enormous increase in production. Eventually tea planters were forced to the restriction of output by resorting to finer plucking. In the case of rubber, restriction was rendered comparatively simple by the fact that the rubber tree acts as a reservoir for latex when it is not tapped. In the case of cocoa trees giving a definite annual crop, if the pods are not picked, not only are they lost as regards production but, in addition, harm may be done to the tree. Hence the limitation of output on a cocoa estate is attended by difficulties not experienced in the case of rubber. It is to be hoped that a limitation may not be necessary and it should not, provided a comprehensive advertising campaign is intelligently conducted, but planters should be prepared to exercise such control and limit any increase in production to the amount which is justified by a definite increase in the world's demand for cocoa. The restriction if necessary, might be brought about in a variety of ways. It might be stipulated that no additional plantings should take place except by licence, the granting of which might be made to depend upon price levels over definite periods. Or, alternatively, the true productivity of an estate might be assessed by competent officers by taking the average yield of a normal period of years, allowance being made for trees which are likely to cease bearing, and for newly planted areas which have not come into full bearing. This " standard production " might be re-assessed periodically if there was any reason to suppose that the " standard production " did not represent the true productivity of the estate. A certain percentage of the standard production should be exportable at a nominal rate of duty. Any export in excess of the standard production should be subjected to a heavy tax which would, in effect, tend to make production approximate to the " standard production." This would have the advantage of stimulating planters to produce very high trade cocoa and to eliminate trees producing poor quality beans and trees of low productivity. As a second alternative, restriction might be effected by stipulating that cocoa above a certain grade only should be exportable. The grade might be varied according to the condition of the markets over certain specified periods. This system would have the advantage of ensuring that only cocoa of a higher grade would be exported and consequently the highest prices realised, but on the other hand might re-act very seriously upon planters whose whole crop consisted of low quality cocoa. The elimination of such producers would be for the permanent benefit of the industry but the hardship upon individuals must not be overlooked. Whichever system is adopted implies a comprehensive and an expensive system of supervision by the Government or some other universally accepted authority.

It is essential too that all cocoa producing areas, or at least a very large percentage, together with the bulk of the potential producing areas should be incorporated into this body, otherwise it will be found that the beneficial aspects of the efforts of those countries within the organisation will be absorbed by areas outside, which are enabled to increase their production and share in the enhanced prices without contributing one iota of the expenses, and without rendering themselves subject to any restrictions which must inevitably arise from becoming a member of such a body. This has been the unfortunate experience of those countries which organised themselves to restrict the output of rubber for the purpose of raising prices to remunerative levels. When the scheme was inaugurated the bulk of the existing producers came into line, but those which remained outside have increased their production to such an extent that a worse

period of over-production, and consequently still lower levels of prices are within sight. Dissatisfaction is consequently aroused in those countries which sacrificed present temporary advantages for expected future permanent benefits.

Thus far we have paid no attention to that highly important individual, the consumer. How is he likely to be affected by such an organisation? The general undifferentiated consumer is inclined by bitter experience to regard all such amalgamations of producers with considerable suspicion, since he has learnt to consider them as the prelude to higher prices and "profiteering." The consumer would probably benefit chiefly from the fact that he was ensured of obtaining really pure cocoa. Too often the name "cocoa" has been applied to a mixture containing arrowroot and other ingredients in addition to pure cocoa. The greatest fear of the consumer, however, is that prices would be considerably raised by the formation of an alliance of cocoa producers. It should be realised that in its uses as a beverage a number of substitutes for cocoa already exist, particularly tea and coffee, and if by any interference with what we may for convenience term the normal action of supply and demand, prices were raised unduly, consumers would naturally turn to tea and coffee or merely diminish their consumption of cocoa. Apart from this it is certain that all producers would be anxious to take advantage of increased prices and, in the normal course of events, production would increase and prices return to more reasonable levels. It should be emphasized that the object of the organisation would be to raise and maintain prices at a remunerative level, and not to indulge in profiteering at the expense of the consumer, nor, on the other hand to allow prices to remain at levels distinctly unfavourable to the producer. In its other main uses the elasticity of demand for cocoa is considerable, and any abnormal increase in price would be immediately followed by a diminishing demand.

The objects of the organisation are praiseworthy but the difficulties are enormous. The scheme is likely to suffer more from its enthusiastic supporters than from its most ardent critics. The facts that costs of production can be considerably reduced by the introduction of improved methods of cultivation, that, alternatively producers must be prepared to restrict or to control output, and that all, or nearly all, of the existing and potentially important producing areas should be incorporated into the scheme, should be kept well in the foreground, otherwise irreparable damage may be caused to all interested in cocoa. Organisation should come through local societies. It is essential that these bodies should take the initiative since success depends upon a full measure of co-operation, and true co-operation cannot exist if the system is imposed by some higher authority. The advantage to the producer must be obvious and, unlike many a similar organisation, is not likely to re-act unfavourably upon the consumer.

INDIAN COTTON.

Morphological factors influencing yield.

PROF. S. C. HARLAND, D.SC., F.L.S.

THE present writer in 1918 showed that in a number of strains of Sea Island cotton a strong positive correlation existed between the weight of lint borne by a single seed and the yield of lint per acre.

The importance of the correlation between lint per seed, lint per plant and lint per acre is enormous from the point of view of the plant breeder, for it becomes an easy matter for him to increase yield merely by selecting for high weight of lint per seed. Due regard should of course be paid to the selection of strains resistant to shedding, and a desirable habit of growth should also be attended to in the course of selection.

A recent paper by Kottur presents data on certain of the characters of Indian cotton which have been shown to influence yielding power in Sea Island, and an analysis of his data will be instructive.

Kottur presents data on the varieties Kumpta and Dharwar No. 1 the spacing being 24" x 18".

1917-18.	*Flowers per plant.*	*Bolls per plant.*	*Bolls to flowers.* %
Dharwar No. 1	.. 23	16	67
Kumpta	.. 37	15	41
1918-19.			
Dharwar No. 1	.. 28	19	69
Kumpta	.. 47	19	40

Other data which it is possible to obtain from Kottur's paper either directly or by calculation are placed below, together with a comparative set of data of the heavy yielding strain Sea Island H 23, isolated in Montserrat by the late Mr. William Robson.

	Dharwar No. 1.	*Kumpta.*	*H 23 Sea Island.*
Seed weight in mg.	.. 55	52	136
Lint weight in mg.	.. 22	18	59
Ginning percentage	.. 28·5	25·5	30·4
Mean Boll loculi	.. —	3·0	3·6
Ovules per loculus	.. —	6·5	—
Seed per boll	.. —	19·5	21·7
Lint per boll gms.	.. —	0·35	1·23
Seed cotton per boll gms	.. —	1·36	4·23

It will be seen from the above that while the percentage of bolls to flowers is much greater in Dharwar than in Kumpta, the number of bolls per plant is approximately the same in the two strains in two successive seasons. The weight of lint per seed is, however, 22 per cent. greater in Dharwar. If the mean number of seeds per boll and number of bolls per plant are not materially different in the two types, the increased weight of lint per seed of Dharwar should reflect itself in an increased yield of lint per acre. Actually according to Kottur's figures

the increase in yield of lint per acre has been roughly, 35 per cent. Some of this increase is probably due to the greater weight of lint per seed of Dharwar. One would hardly wish to stress the point too far, but it is obvious that analyses of this kind are of the utmost value in selection for high yield, a weak point in a strain being instantly revealed.

THE MOSAIC DISEASE.

Beneficial Aspect.

THE Department of Sugar Technology has recently received an article written by Mr. A. H. Rosenfeld entitled "The Beneficial Aspect of the Mosaic Disease." Mr. Rosenfield is the sugar cane technologist for Porto Rico, and has spent several years there studying and investigating agricultural conditions in regard to sugar-cane.

He points out the benefits that were derived from the epidemic of boll weevil which spread through the American Southern States, several years ago, and threatened to destroy the South's greatest crop, and source of income. Up to this time the whole of the Southern States was practically a one-crop area, with the possible exception of Florida, and was almost wholly dependent upon cotton for its livelihood. The wholesale destruction of the cotton crop by the boll weevil caused them to divert their attention to other crops, which perhaps would not be so complete a failure. This was the beginning of diversified farming in the South, and the farmer to-day in almost every part of that section is no more entirely dependent upon one product as a means of livelihood, but has diversified his crops to such an extent that should one prove a total failure, he would not be ruined financially.

A rather significant and interesting event mentioned in this article is the erection of a monument to the boll weevil. In a small town in the South, the farmers have contributed to the erection of a monument to their friend, the boll weevil. For years they struggled with cotton and the boll weevil, until being practically ruined, they turned in desperation to truck farming. Their success was very marked, and in a few years the section became one of the wealthiest truck farming areas in the United States of America. They became prosperous and happy again. Hence their appreciation and gratitude to the boll weevil.

Although not exactly a parallel case the epidemic of mosaic disease in Porto Rico in 1916 caused an economic condition in the cane industry very similar to that which existed some years previous in the cotton industry. The latter condition being caused by the boll weevil. In the case of the boll weevil epidemic the benefits to the farmers were realised in crop diversification, and this indeed was their salvation. Whereas in the case of the epidemic of mosaic disease in Porto Rico, the benefits were mainly derived from the closed attention to agricultural and farming methods, the selection of immune varieties, the promotion of interest in scientific methods of farming and cultivation, the closest studies of varieties with an idea of choosing those of the hardiest and most resistant types. And finally the education of the farmer to the fact that the sugar is made in the field and not in the factory.

These points are clearly brought out by Mr. Rosenfield, and after reading his article, one cannot help but feel that he is quite right, and that the mosaic disease has been really as beneficial to the cane growers, as was the boll weevil to the cotton growers.

O. F. B.

COFFEE.

COFFEE and its position from the point of view of production and consumption is dealt with in a British and an American Journal both dated October, 1924. The former, *Imperial Commerce* discussed the coffee situation as seen from the British side and the latter *The Tea and Coffee Trade Journal* from the American side.

They agree that the people of Britain and British possessions are not coffee drinkers and that British possessions do not produce a large portion of the world's coffee, but they differ as to prospects for the future and they both refer to the exhibits at Wembley as illustrating to some extent the points they each make.

From these sources of information it would appear that the British Empire produces only about 2 per cent. of the coffee of the world and at the same time Great Britain, Canada and Australia are near the bottom of the list of coffee consumers. The consumption in Great Britain being reckoned at under 1 lb. per capita per annum, in striking contrast to the average consumption in the United States of America of 11 lb. per capita.

The use of coffee as a beverage in England dates back to about 1652, long before tea had found its way to that country, but tea has increased in popular favour and left coffee far behind.

Coffee is believed to have originated in the highlands of Abyssinia. During the latter part of the 17th and during the 18th centuries it was introduced into Java, Jamaica, Martinique, and Brazil and since that time has been cultivated in nearly every portion of the tropics.

About the middle of the last century, Ceylon had a very flourishing coffee industry, producing over a million cwt. valued at 2½ million pounds sterling. The ravages of the coffee leaf disease practically wiped out the coffee industry of Ceylon which has gradually been replaced by tea.

Coffee is an important industry in India where something like 210,000 acres are under cultivation

to this crop, about half of which area is located in the native state of Mysore.

In Jamaica, coffee cultivation has been carried on for a long time but on comparatively small scale. The Blue Mountain coffee of Jamaica is famous for its quality, which is indicated by the very high price it always commands in the market.

In British Guiana, also, coffee has been a crop of great importance, and at the present time there is probably something like 5,000 acres cultivated in that Colony. In all the islands of the Lesser Antilles coffee has in the past been of some importance, Dominica at one time having very extensive coffee plantations and shipping large quantities of coffee to the European markets.

In Malaya, also, very large areas of coffee were under cultivation previous to the introduction of Para Rubber, which has almost entirely superseded coffee there.

On the whole, it is estimated that coffee cultivation in the British Empire is on the decrease although in some places the area under cultivation remains fairly constant, as in India, and in others a very lively interest is being manifested in the development and extension of this crop as is seen in East Africa and Uganda.

In Kenya Province the area planted in coffee has nearly doubled in the last five years. The area in 1920 being given as 28,833 acres, and in 1923 as 52,249 acres while the production has risen in the same period from about 72,000 cwt. to over 90,000 cwt. and it is estimated that the newer plantings which are coming into bearing will more than double the output in the next five years.

In Uganda, extensive trials have been made with coffee as a crop and in 1923 it was estimated that about 41,000 cwt. was exported having a value of £108,000.

Only about one-third of the coffee used in Great Britain comes from sources of production within the Empire, the great source of supply being Brazil. Of the coffee exported from India, Great Britain takes about one-third, about half of that from Jamaica, and about two-thirds of that from Kenya and Uganda.

Of the British Dominions, South Africa is the only one where coffee is used on a large scale, the per capita consumption being something over 4 lb. per annum.

The United States of America. using about 11 lb. per capita, is the ultimate market for about half the world's total production.

With the very high rate of consumption in those countries where the use of coffee is very general and the slow rate of increase in other countries where this beverage has not found universal favour, it might be asked whether in view of the active development that is taking place in some parts of the Empire there is not grave danger of over-production.

In Ceylon a most flourishing and valuable coffee industry was practically wiped out by a fungus which attacked the leaves of the coffee tree. In every country where coffee is grown there are insect pests and fungoid diseases which take their toll of the crops, and if development proceeds more rapidly than the knowledge of how to control pests and diseases, there is always a likelihood of a serious check. Also many insect pests in a country where they are native may be only of minor importance but if introduced into a new locality where they may come under the influence of a new environment and in the absence of their natural enemies may develop to such an extent as even to result in the extermination of the crop.

The coffee berry borer, a minute beetle which lives in the pulp and seed of the coffee berry is widely distributed throughout East Africa and the Malayan district. Although a serious pest in these places, where it appears to be native, it has not prevented the successful cultivation of coffee, nor does it seem to be interfering with the development of new areas under this crop. This insect has recently, however, made its appearance in Brazil where its ravages are causing the gravest concern, not only to coffee planters, but to Government as well. Coffee forms a large proportion of the exports of that country, in 1923 amounting to two hundred and twenty-nine million dollars, or 64 per cent. of the total.

For about five years past the coffee berry borer has been known to exist in certain states in Brazil but has not, until recently, attracted much attention. The districts now known to be infested contain some eighty million coffee trees, and it is calculated that the actual loss in crop within these areas will be from 10 per cent. to 20 per cent. Small samples of coffee which have been examined have shown as much as 60-80 per cent. loss. All known lines of investigation are being followed with the hope of finding some method of control but the outlook is serious, and shows how the introduction of a pest may suddenly interfere with production and threaten a shortage in a world's crop where formerly there had been a surplus.

In years gone by the Arabian coffee was most generally used in the coffee trade. Then followed Liberian, and at the present time these and two other species *Coffea robusta* and *C. stenophylla*, are all cultivated on a commercial scale. Each of these varieties has its peculiarities as to soil and climatic requirements, and they will probably be found to have special characteristics in the matter of resistance to pest and disease attacks.

These specific differences have been especially noticed in connection with the attacks of the coffee leaf-miner, the larva of a small moth which tunnels in the tissues of the coffee leaves. The Arabian coffee suffered very much from the attacks of this pest, while Liberian coffee, in the same localities was found to be almost free from them. Whether a choice of varieties will afford a means of combating coffee berry borer remains to be seen.

H. A. B.

THE TROPICAL WORLD.

Barbados.

The Colonial Report for Barbados for 1923-24 (No. 1225) contains some highly interesting information as to the economic condition of that Colony. The year 1921, following the collapse of the sugar market in 1920, reduced the Colony to a very depressed state, unfavourable trade conditions being aggravated by drought and resulted in a reduction of the sugar crop to the lowest level recorded for many years. The succeeding two years have been a period of retrenchment and recovery and have afforded a remarkable display of rapid recuperative power which is strikingly illustrated by the history of the Government finances during that period.

At the end of 1921-22 the actual deficit was £65,000, the unsecured floating debt £85,000 and the reserve fund had dissappeared. By April, 1924, the whole of the floating debt had been paid off and a credit balance of £96,486 had been established. The customs surtax of 20 per cent. which was in operation for two tears has now been repealed as being no longer necessary.

This result has been accomplished by a combination of careful financial measures together with a revival of more favourable conditions for the sugar trade. The exports of sugar for 1923 were equivalent to 62,711 tons, valued at £1,820,571 an increase of about 20 per cent. in quantity, and nearly 100 per cent. in value, over the results for 1922 and over 70 per cent. in value above the 1921 output.

Owing to emigration the population has declined steadily during the last two decades, though its numbers (158,000) are still considerable for so small an area. The effect of the constant withdrawal of so large a number of the younger and more vigorous members of the community, especially the younger men, is beginning to make itself felt.

Much public attention and criticism was directed to the conditions of the roads. Barbados contains about 500 miles of public highway, a very large amount for an island of this size. The growth of motor traffic and the concentration of heavy traffic in recent years, due to the establishment of larger sugar factories, has resulted in a progressive deterioration of the surface of the main roads, and it seems evident that the method of repair which sufficed for the lighter and slower traffic of pre-motor days is not adequate to withstand the greater wear and tear of modern conditions. The care of the roads is in the hands of the parochial authorities, but proposals have been made for placing the main arterial roads under a central authority.

Altogether the year 1923-24 was one of exceptional prosperity for the island and those responsible for its administration are to be congratulated on the magnificent recovery from the depression of the previous years.

Morocco.

The *International Cotton Bulletin* gives an interesting account of the condition of the cotton industry in Morocco. The cultivation of this crop in Morocco started with the establishment of the French Protectorate, and at present it is still in its infancy ; 10 hectares in 1923 giving an average return of 300 kilogrammes of ginned cotton per hectare. The attention of the French administration has been drawn to the possibilities of extending this industry, as the climate, and soil conditions appear to be favourable.

Experiments were undertaken and the conclusion arrived at that irrigation is essential for satisfactory results to be obtained. Owing to the late cold, seed can only be sown at the end of April and beginning of May, at a time when the rainfall is negligible and on the other hand the early cold puts an end to all vegetation at the end of October-November, so that the plant is obliged to accomplish its growth practically without water.

The region which appears to be most suitable for the growth of cotton is Marrakech, the most favoured district both in respect of irrigation and labour supply. The irrigable areas of this region are extremely fragmented and various trees and textiles such as olives, figs, almonds, oranges or maize, hemp and lucern are grown.

But there are important areas, still uncultivated, where cotton-growing could be profitably attempted. The culmination of the irrigation schemes planned by the Protectorate will allow experiments to be carried out in Western Morocco especially in the Marrakech region.

Eastern Morocco is more favoured by nature for the growth of this crop. Some small proprietors of the Triffas plain, where fairly considerable supplies of water had been held by the sub-soil at shallow depth, have successfully grown a few hectares of cotton.

British Honduras.

The correspondent to *The Times Trade and Engineering Supplement* reports a large increase in the exports of copra from British Honduras, The value of the external trade of the Colony during 1923 amounted to $7,233,572, or $1,125,573 more than in the previous year. There was an increase of $746,286 in the value of the imports and of $379,287 in the value of the exports.

Of the imports the United Kingdom supplied goods worth $919,915, an advance of $252,503 compared with the previous year ; the share of Canada was $357,788, or $201,038 above the 1922 figures ; that of the United States, $1,859,506; against $1,890,690 in 1922. Of the exports the United Kingdom took $328,924 ; Canada, $18,369 ; other British possessions, $321,608 ; the United States, $2,227,330 ; other countries, $301,961. Mahogany and chicla continue to be the chief items of export, 10,000,000 feet of the former and 2,206,009 lb. of the latter being exported in 1923. The trade in copra increased from 448,300 lb. in 1922 to 1,831,085 lb. last year.

British Solomon Islands.

The Bulletin of the Imperial Institute Vol. XXII No. 3, 1924 contains an interesting article on the British Solomon Islands, one of the less known parts of the Empire. These islands have in recent years assumed some degree of importance owing to the extension of coconut cultivation for the preparation and export of copra. The climate of the Protectorate cannot be described as healthy, malarial fever and dysentery being prevalent. The geology of the islands has not yet been the subject of any detailed study but an interesting general description is to be found in Mr. H. B. Guppy's "*The Solomon Islands and their Natives*" published some thirty years ago, and a more detailed account in "*The Solomon Islands: Their Geology, General Features, and Suitability for Colonisation*" by the same author. The region is mountainous and predominantly of volcanic origin, though many coralline and other lake formations are met with. One active volcano still exists, that of Tinakula, a small island about twenty miles north from Graciosa Bay in the Santa Cruz group. Seismic disturbances are common in the Protectorate and are occasionally very severe, the entire population of Savo being several times on the point of abandoning the island, because of the heavy earthquake shocks in that locality. The native population is estimated at 150,000 but reliable figures are lacking. The white population in March, 1922, was less than 500, and the number of Chinese and other immigrants small. The fauna and flora are of great interest but the flora is still very imperfectly known. Although many valuable timbers are known to exist and numerous plants are employed for various purposes by the native population, the coconut palm is at present, with few exceptions, the only tree of economic importance. Agricultural development is retarded by the lack of an adequate labour supply, the only labourers now available for employment in the plantations being the indigenous population, which, in spite of the cessation of recruiting for the Queensland plantations in 1903, and for work in Fiji in 1910, is totally inadequate for present requirements. Two-thirds of the labourers, who engage under contracts for two years, come from the island of Malaita, the total expenses for recruiting, maintenance, and return to Malaita being about £60 for a two years' contract. In view of this shortage of labour, planters devote most of their attention to crops which do not require a plentiful, regular and to some extent skilled labour supply. Coconuts which, with efficient supervision, require only unskilled labour find special favour, the cost of bringing to maturity varying from £60 to about £30 per acre. As a rule an estate does not become self supporting until the 8th or 9th year, and dividends cannot be expected until the 11th or 12th year. Extensions however, have been continuous since British authority was established in the Protectorate and non-natives now own and cultivate some 30,000 acres. Copra forms by far the largest part of the exports, the quantity shipped in 1921-22 amounting to 12,109 tons, but coir is not manufactured owing to the shortage of labour. Good quality rubber has been grown on some plantations, but low prices have retarded development. Cotton and Manila hemp have been favourably reported on. The chief exports next to copra have been Trocas shells, ivory nuts, timber and bêche-de-mer. The total value of exports rose from £89,000 in 1910-11 to £336,500 in 1920-21, of which total copra accounted for over £300,000. In 1921-22 exports fell to £182,887 but rose again to £231,698 in 1922-23. The revenue has increased from £14,000 in 1910-11 to £56,741 in 1922-23.

Cameroons.

We are indebted to the *International Cotton Bulletin* for information concerning cotton cultivation in the Cameroons. Cotton is grown particularly around Haroua, Dechang, Yaounde, and Lomawher, the production being absorbed by the local needs. Two factors, namely labour and means of transport, limit cultivation. The Northern region, where the soil is composed of clay and silica and not irrigated, is especially suitable for cultivation.

This region has a river port, Garoua, on the Benoué, which is only accessible for a short period at high tide. Frequently the rise in tide is not sufficient and this, combined with the want of steam tonnage (an English monopoly), and the excessive freight, is a serious obstacle to the development of the industry. As, however, this district possesses good roads which can easily be made fit for motor traffic the Government is planning to connect it as early as possible with the central rail head.

The Government is also trying to supply good seed to producers so that a product of uniform quality may be produced by eliminating little by little the varieties producing an inferior cotton. Concessions of land for the purpose of growing cotton will also be given but the authorities will not undertake either to forward labour or to guarantee interest on capital.

From different experiments it has been found that the cotton of the Cameroons is comparable in quality to the average varieties of Egypt. Length of fibre is variable according to the variety but it is hoped to better this by selection.

It is difficult to estimate the yield per hectare or the cost of production by the native but trials are in progress to determine the cost of production by Europeans.

Statistics compiled by the Germans in 1913 state that the price of one franc to one franc fifty per kilogram of unginned cotton can be taken as a basis. During 1923, at Garou, the producer was paid one franc a kilogram for unginned cotton and two francs for ginned.

Java.

From a recent number of the *Board of Trade Journal* we learn that during the year ending July 31st, last there was a great revival in agricultural industries throughout the Dutch East Indies, prices being favourable and no difficulties being experienced in the disposal of native and estate produce. Full advantage was reaped of a reduction in working costs, for which general measures had been taken during 1922-23. Agricultural diseases and insect pests were more limited than in previous years. In Java tea planting has been extended, and many applications have been received for permission to rent from native holders irrigated rice land for the extension of sugar plantations, and several concessions for this purpose have been granted. Irrigation works undertaken by the government have resulted in a large tract of country centering around Krawang, in West Java, being rendered suitable for the growing of sugar, and a concession for this purpose, applied for by a British Company, is receiving favourable consideration. The importance of the founding of a sugar industry in West Java cannot be over-estimated.

The extension of the cultivation of agave fibre or sisal brings this industry to the front rank of important cultures, while for new plantations now being developed no expense is spared, the very latest machinery and best equipment known being laid down, so that their success seems assured.

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Rhodesia.

Interesting information concerning the proposed Sinoia-Kafue cut-off as a development line is furnished by the correspondent of *The Times Trade and Engineering Supplement*. This proposed railway, which would shorten the route from Katanga and Northern Rhodesia to the ocean port of Beira by 550 miles, would also be of great value as a means of opening up a large area of fertile and highly mineralised country in the middle Zambesi valley.

With regard to the possibilities of river navigation as a feeder to the proposed railway, the Kafue River is navigable during eight months of the year for a distance of 30 miles from Malue to its confluence with the Zambesi at Kanyenmba Island. The two or three rapids which exist are merely formed by drifts of sand, and the expenditure of a little money would provide a channel navigable throughout the year. Both banks of the river are very fertile and some excellent sites for farms exist in the valleys that run back from the river to the north and west.

Navigation is fairly easy from the confluence of the Zambesi and Kafue downstream to well below the Anglo-Portuguese frontier at Feira, and upstream to the site of the proposed railway crossing over the Zambesi at the Kariga gorge. This navigable system, which is about 400 miles long, could be utilised by farms, mines, and timber concessions to transport their produce to the railway at Kariba.

The Kafue and Zambezi escarpments are mostly composed of limestone known to contain potassium nitrate, and phosphate. The erosion of the limestone during long periods of time and the leaching of its salt content is the cause of the magnificent fertility of the valley immediately below the escarpments. Extensive deposits of phosphates in the form of guano occur in caves throughout the whole extent of these limestone cliffs—some 150 miles. Corn, maize, and tobacco thrive well everywhere. Cattle and sheep seem to be in better condition throughout the valley than in any other cattle rearing district the correspondent has seen in Northern Rhodesia.

The 200 odd miles of railway comprised in the Sinoia-Kafue cut-off would open up directly 100,000 square miles of the Empire in the Zambeis-Kafue valleys alone, besides converting land and mines in Northern Rhodesia, that are now handicapped by having to pay railway rates over a superfluous haul of over 500 miles, into paying concerns.

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Madagascar.

Practically all the cotton from this island is native grown says *The International Cotton Bulletin*, the amount under cultivation being approximately 2,000 hectares. All the alluvial valleys of the rivers from the Western watershed of the island (about 300,000 hectares) are suitable for cotton cultivation but on the high plateaus and the Eastern Coast the climate is quite unsuitable. It is therefore in the south-west of the island that cultivation should be tried on a large scale. This region is very fertile and thickly populated so that there need be no difficulties as regards labour supply. The navigable rivers can be used as means of transport but apart from this human porterage must be utilised.

The native cultivation gives a very poor return, the maximum being 80 to 150 kilogrammes per hectare as against 250 to 300 from the European cultivations, and practically the whole crop, which cannot be even approximately valued, is utilised by the natives.

This island has no ginneries, some saw-gins sent by the Colonial Cotton Association being the only ones used.

An active campaign for developing the industry particularly in the south-west of the island, appears to have a promising outlook. The Government is willing to co-operate with the Colonial Cotton Association by giving concessions, helping in irrigation schemes, distributing selected seeds and planning technical studies of the best cultural methods.

The Colonial Cotton Association has sent out an experienced agronomist to report on the soil, climate, labour and water-supply, and the possibilities of starting an experimental farm similar to that which has just been erected at Koutiala (French Sudan), with the addition of a model factory with modern equipment.

Kenya.

The dominant political feature in the history of the Colony during the year was the decision upon the status of Indians in Kenya. This question had been a source of contention for a considerable time, and by the beginning of 1923 had become a matter of Imperial policy.

In respect of political status, it was decided that "having regard to all the circumstances, the interests of all concerned in Kenya will be best served by the adoption of a communal system of representation." Five seats on the Legislative Council were allotted to the Indian community and one seat to the Arab community, all on an elective basis. Segregation in townships was to be abolished; and while the reservation of the highlands for Europeans was maintained, the temporary reservation of land in the lowlands outside the limits of native occupation and requirements was promised for Indians, in order that "it may be ascertained by experience what demand there is for agricultural land on the part of Indians who will give suitable guarantees of their intention to develop the land themselves." As regards immigration it was made clear that the immigration laws of Kenya had no racial basis.

The decisions rested on the broad basis of the British trusteeship for the African, and it was clearly recorded that the primary duty of the Colonial Government is the advancement of the African.

His Majesty's Government thought "it necessary definitely to record their considered opinion that the interests of the African natives must be paramount, and that if, and when, those interests and the interests of the immigrant races should conflict, the former should prevail"; and further that the Act of Annexation in 1920 "in no way derogates from this fundamental conception of the duty of the Government to the native races. As in the Uganda Protectorate, so in the Kenya Colony, the principle of trusteeship for the natives, no less than in the mandated territory of Tanganyika, is unassailable."

Australia.

From a recent number of *The Chamber of Commerce Journal* we learn that the production of sugar from Queensland and New South Wales is likely to reach 390,000 tons, the season having been a phenomenally good one, and the sugar contents of the cane having exceeded the most sanguine expectations. The surplus is likely to be 80,000 tons or more, and this opens up the serious problem of disposing of the surplus. So far, arrangements have been made to export about 45,000 tons. The world's price for sugar to-day is, roughly, £20 a ton, and as the price paid for raw sugar in Australia to the mills is £27 a ton, a loss of £7 a ton will have to be faced, less a certain amount of preference granted by Great Britain to Dominion-grown sugar. In spite of the very favourable condition of the industry in Australia, efforts continue to be made to induce the Commonwealth Ministry to renew the embargo on the importation of sugar which expires on June 30, 1925.

The correspondent of *The Times Trade and Engineering Supplement* gives some interesting information concerning state trading in Queensland. In the last ten years the debt has grown over £36,500,000. A large proportion of the increased indebtedness is traced to the Labour Government's State enterprises, which owe the Treasury £2,284,000 and continue to be run at a loss, last year's adverse balance being £85,691. The State Stations are the heaviest drag, a loss of £105,000 more than counterbalancing small profits on butchers' shops, the produce agency, railway refreshment rooms, and the State hotel. The State fishery and cannery also helped to swell the debt.

The railways which are owned by the Government, and are regarded as separate from State enterprises, were again run at a heavy loss, the year's working failing to meet interest charges by £1,593,000. This result is recorded in the face of rising revenue. Parliamentary criticism attributes this loss to political interference. State smelting works in the big copper country round Chillagoe were again operated at a loss and a total deficiency of £282,000 has been written off. The Mount Mulligan State Coalmine shows an accumulated deficit of £188,000.

Trinidad.

We learn that Professor Farmer, Governor of the Imperial College of Tropical Agriculture, and Mr. Kilby, Secretary of the Empire Cotton Growing Corporation, sailed for Trinidad on January 10, to investigate the possibility of establishing a Cotton Research Station in this Island, under the auspices of the Empire Cotton Growing Corporation. The Corporation had requested Dr. Leake, Principal of the Imperial College of Tropical Agriculture to present a report on the degree to which Trinidad possesses the desiderata for the site of the Corporation's proposed research station. It is recognised as a distinct feature in favour of Trinidad that the staff of the research station would be able to discuss their problems with the staff of the College. Dr. Leake has been able to present an encouraging report regarding the climatological factors. It is true that Trinidad as a whole is not suited for cotton-growing on a commercial scale, but it so happens that the tract where the College is situated is, in his opinion, particularly well suited. The fact that Trinidad is not a cotton island commercially would perhaps be actually an advantage, since when an experimental station growing several types of cotton is situated close to a commercial crop of one variety only, there is always a serious risk of causing damage, by hybridization, to the quality of the seed used for the commercial crop.

SOIL MANAGEMENT PROBLEMS.

PROFESSOR J. SYDNEY DASH, B.S.A.

ALTHOUGH our knowledge concerning soil fertility has undergone considerable change since the days of Van Helmont and his willow tree experiment, Tull and others, it is only during the last hundred years that the more fundamental contributions to the study of soil science and plant nutrition have been made; in this connection, such names as de Saussure, Liebig, Hellriegel, Lawes, Gilbert, Cameron, Whitney, Hall and Russell—to mention only a few representing various schools of thought up to the present day—should be familiar to everyone. During the period previous to 1804, nitre, water, air, fire and earth had at various times been regarded as agents in the nourishment of plants. Readers may be reminded particularly of the conceptions of Tull who taught 200 years ago that soil particles constituted the real food of plants and that if these were made fine enough by cultivation, the plants could then absorb these fine particles and produce crops continuously. With the discovery that the food of plants was both mineral and gaseous, the former from the soil and the latter from the air, the belief soon grew as a result of chemical and mathematical considerations that soils would eventually become exhausted from cropping unless provided with new sources of plant food. Thus, the developments arising from the investigations of Lawes and Gilbert on the problem of providing readily available substances to be added to soils in order to satisfy crop demands, and which paved the way for the extensive use of commercial fertilizers, further emphasized the view among chemists and agriculturists that all that was necessary was to feed the plant.

Up to this point, the plant itself had received little attention; it is now recognized, however, owing largely to the researches of the geneticist, agronomist and physiologist, that soil, plant and climate must all be reckoned with as factors in crop production. This does not mean that the chemical aspect of soil treatment has lost in importance; to mention only one recent investigation bearing on this question, in Hawaii studies on potash requirements of cane soils indicate that those containing more than ·03 per cent. of potassium oxide soluble in one per cent. citric acid will not give profitable returns from potash applications. On the other hand, it is certain that no one branch of agricultural science can claim a monopoly in what concerns the all important question of raising crops plentifully and profitably. Indeed, the more closely it is studied the more complicated the problem seems to become, and in the final stages the agricultural engineer may play not the least part.

As a result of field and laboratory investigations up to the present time, there emerges the general fact that the tiller of the soil need no longer be unduly worried over the probability of soil exhaustion to a point where it will cease to produce; rather, he should be concerned with maintaining fertility at a standard which will allow of crops being grown at maximum profits and minimum expense compatible with the requirements of permanent agriculture. In this connection, what causes the greatest possible concern—and for which adequate remedies are not yet forthcoming—is the heavy soil losses, apart from crop demands, to which good agriculturists are subjected year in and year out. To suppose that because a careful planter, by sound methods of management, puts into his soil much more food materials than his crop needs must expect to lose that which is not wanted, is equivalent to supposing that because a millionaire banks much more money than is necessary for his needs, the surplus should be lost. Awaiting a satisfactory solution of this problem, the good agriculturist in order to keep fertility up to the standard already indicated, must not relinquish his efforts in respect to tillage, manures, amendments, rotations and the like, and the use of every possible means to prevent erosion and soil wash—both responsible for heavy losses under tropical conditions.

Dealing first with tillage, we are reminded forcibly of Tull's theory mentioned earlier and its corollary—tillage is manure. It is true to-day in the sense that tilling the soil helps to make potential plant food available and also provides better environmental conditions for plant growth. It is an aspect of soil management which is assuming increasing importance and must continue to do so in proportion as populations increase, sources of fertilizers become more and more exhausted, and with the growing recognition that crops need other things besides food. Slowly but surely these facts must reach the tropical planter who has hitherto depended too much on the natural conditions of soil and climate; he should understand that perfection of factory and technological methods in the preparation of his produce mean little or nothing in the long run if the fields are not producing the raw material, and further, it is a sound economic law that improvements in one direction invariably call for improvements in another. Thus, the agricultural engineer in the handling and development of power and implements for efficient tillage, cultivation, irrigation, &c., with a view to increasing production and lessening costs is equally as necessary as the factory engineer. Moreover, tropical soils by virtue of their often compact and heavy nature demand that greater attention be paid to tillage and such practices which improve texture and tilth rather than the mere application of fertilizers.

Of all the manures at the disposal of the agriculturist, farm manure is the most important; unfortunately, in many parts of the tropics labour, cost of making and applying is given as a reason for its limited use. Judged as a supplier of plant food only, this attitude is probably the correct one; as a tilth improver, however, there is scarcely anything to equal it. Measurements at Rothamstead have shown a saving of over

22 per cent. on the power consumption required for ploughing dunged as compared with undunged soil; added to this is the gain in moisture content of the soil as a result of dunging, 5 per cent. and even more being reported—an important consideration where droughty conditions have to be faced. Its influence on the microflora of the soil should also not be lost sight of. Balancing cost with benefits, we are inclined to think that taking into account all the circumstances of crop production in the tropics, expenditure on farm manure is justified. Where few animals are kept, what can be achieved with a Mauritius pen described in Vol. 1, No. 8 of this journal should be borne in mind. Green manures are useful aids in supplementing farm manures, but they are not suited to all soils, and under conditions of poor rainfall may be distinctly prejudicial where moisture is lost through excessive transpiration from the green crop. With regard to their disposal in the soil, it is believed by some that the plants should be allowed to wither after cutting before being turned in. Obviously, the problem needs further investigation since when turned in withered much moisture will have been lost and the soil moisture drawn on to assist in decay, the succeeding crop not infrequently suffering as a result; on the other hand, if buried fresh in such a way that capillary action is interfered with and air excluded, as often happens where hand labour is practised, the early development of the crop that follows will be hindered. Passing a roller over the green growth and then discing in the material seems to offer the most efficient means of disposal. It is interesting to note that all crops do not appear to be able to make use of the soil nitrogen accruing when legumes are grown; for example, at Woburn Experimental Farm, investigations carried on year after year show that neither wheat nor barley seem to benefit from the nitrogen left by a tare crop, and the reason is not yet fully understood. Work of this kind on tropical crops should produce valuable results.

On fertilizers and amendments, little need be said of the substances usually employed as such and which are familiar to all agriculturists. Attention may, nevertheless, be drawn to the influence some exert in relation to tilth and resistance to passage of implements. At Rothamstead, a saving in power varying up to 15 per cent. was obtained by chalking heavy land; in this connection, the use of ground limestone is becoming more general and recent results with it on a sugar estate in Trinidad were referred to in Vol. 1, No. 11 of this journal. It was also found in Rothamstead trials that sulphate of ammonia used along with minerals was beneficial in this respect but that nitrate of soda acted the opposite way and increased the power requirement. Crop plants themselves may act as tilth improvers or otherwise. On newly broken land for example, a deep rooting legume will be found most useful. In the West Indies, the growing of Uba cane on soils of poor physical texture thus replacing other varieties not adapted to such soils should prove beneficial. Unfortunately, as Uba cane has to be burnt before being harvested much organic matter is thereby lost; to offset this to some extent, the last crop of ratoons might be turned in instead of being allowed to mature. On the other hand, the bad after-effects of a crop like sorghum both on the crops that follow and upon the physical condition of the soil have been frequently observed, especially under dry conditions. These bad effects, it may be noted, do not persist, else the growing of sorghum on a large scale would probably have long since ceased. Recent work on the problem as reported in the *Journal of the American Society of Agronomy*, Vol. 16, No. 11, indicates that a toxic body is formed during the decomposition of the sorghum stubble which is soon volatilized or itself decomposed; while it is active, however, the flora responsible for the generation of carbon dioxide is, to a large extent, killed off, and with a cessation of carbon dioxide production, deflocculation of the soil takes place—the opposite effect of liming.

In respect to rotations generally, methods of crop production in the tropics do not often lend themselves to definite rotation practices similar to those favoured in temperate climates. The reasons are mainly economic in nature and it is hardly necessary to discuss them here. It is sufficient to say that the benefits to be derived from some form of crop rotation are no less in the tropics than elsewhere, from a soil management point of view. In any case, it may be confidently stated that the value of a practice so easy to adopt under most conditions as the growing of a leguminous cover crop periodically, on soils subjected regularly to monocultural cropping, cannot be over estimated, even as a weed control measure. This aspect of the subject was dealt with in *Tropical Agriculture*, Vol. 1, No. 4.

Space permits only a brief reference to erosion and soil wash. When it is calculated that over 400,000,000 tons of soil is carried to the sea annually from American territory, that 11,000,000 acres of land have been abandoned and that over 4,000,000 acres have been actually destroyed by erosion, the magnitude of similar losses in the tropics can scarcely be doubted. As the surface soil is principally involved under ordinary conditions of soil wash, the loss of humus and humic substances —by far the most important constituents of soils and the most difficult to replace—gives rise to the greatest anxiety. The problem is now receiving considerable attention, notably in Ceylon and the eastern tropics, where forest land has been cleared to make way for rubber, tea and other crops. Even under arable conditions such losses may assume important proportions where adequate measures are not taken to check the ravages of storm water and floods.

In conclusion, the system or systems of soil management adopted will always be influenced by the law of diminishing returns and the varying

conditions governing crop production. Using sugar as an illustration, the two extremes of Cuba and Hawaii may be cited. In the former, no system of soil management may be said to exist and production per unit of land is low; in the latter, most intensive methods are practised and the yield per unit of land, high—18 tons of sugar per acre being recently reported. The future of the two methods both agriculturally and economically will be watched with very great interest. Between these extremes there are a large number of cases where economic conditions are not so clearly defined and where a middle course seems more desirable, in keeping also with the requirements of permanent agriculture. For them, the question of how much or how little to spend on the land in order to get the best results financially is not easily answered. In solving problems of this kind, the need is for the closest co-operation possible on the part of those concerned.

CITRUS FRUITS.

Forced Colouring.

PROFESSOR F. HARDY, M.A.

IT is well known that the colour of citrus fruits is not always a reliable indication of maturity and palatability. Nevertheless, public taste demands that oranges, lemons and grapefruit should not be offered for sale, at least in northern markets, if their rinds are still green. This imposes a rather serious restriction on the citrus grower, who finds it difficult to arrange his gathering operations so that the colour, shape, size, rind texture, juiciness and flavour of the reaped fruits shall be equally satisfactory at the time when the demands of the markets are greatest. Hence there has sprung up amongst citrus growers, especially in California, a practice whereby green citrus fruits can rapidly be coloured or "cured" by artificial means, without adversely affecting their desirable characteristics.

Originally the curing of citrus fruits was accomplished by storing them in packing houses or tents under conditions of uniform medium temperature and humidity. For lemons, the process took from 30 to 60 days, a period which, however, is too long to meet demands when sales are brisk. Consequently forced curing was attempted by raising the temperature of the houses to 90°F. or 95°F. (employing oil stoves or steam pipes as sources of heat), and increasing the humidity to 90 or 100 per cent. by introducing shallow pans filled with water, or by means of steam jets. The time of curing was thereby reduced to 5 to 14 days. It was soon found that stove heating was much more effective than steam heating in forced curing. The reason for this was shown by Sievers and True (1), of the United States Bureau of Plant Industry, to be that the gaseous products of imperfect combustion of oil fuel (kerosene or petrol) are actually the chief agent inducing rapid colour development, rather than high degree of temperature. Just as good results were obtained when the gases generated in a separate stove room were conducted through pipes to the curing houses, or when the exhaust gases from petrol engines were utilized in the same way.

A search for the active component of stove gas was subsequently made by Denny (2), who employed conventional chemical methods of gas analysis and gas absorption. Although he was unable to determine the exact identity of the active component, Denny demonstrated that it is readily absorbed by bromine, which suggests that it is ethylene or some similar gas. Further experiments showed that ethylene is indeed very effective in bringing about the desired change in colour of citrus fruits even when the gas is diluted by admixture of one to five million times its volume of air.

The modern method of forced curing of citrus fruits (3) involves the use of pure ethylene which can be purchased in steel cylinders containing about 320 cubic feet of the gas under compression. This amount is sufficient to colour from ten to thirty car loads of fruit at a cost of 25 cents to $1.00 per car load. The methods of measuring out the gas and of introducing it into the atmosphere of the curing houses are adequately described by Denny (2). The high temperatures at first thought essential, are now known to be unnecessary, and even injurious. Ethylene will colour oranges sufficiently rapidly for commercial purposes at a temperature of 70°F. to 80°F. and lemons at 60°F. to 70°F. when the humidity is 80 to 90 per cent. In practice, a relatively high initial concentration of about 1 part of ethylene to 5,000 parts of air is advised, since unavoidable leakage and diffusion occur in the curing tents. It is also recommended that the gas be applied twice a day with an intervening ventilation period of about an hour's duration. There is no fire nor explosion risk with ethylene at the dilution mentioned, and the diluted gas, in contra-distinction to stove gas, is neither irritating nor poisonous. The presence of oxygen is essential; indeed it is now believed that oxygen is really the active agent that produces the desired colour change, by bringing about the destruction of chlorophyll, and thus unmasking the yellow colouring matters of the rind. Ethylene appears to act merely as a stimulant to this process, and in no way enters into chemical combination with the rind pigments. Certain other gaseous compounds are almost equally efficacious, but are not so suitable as ethylene because of their greater cost, their toxicity, or their injurious effect on the fruits.

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(2) "*Hastening the Colouration of Lemons.*" F. E. Denny. *Journal of Agricultural Research*, XXVII. No. 10, March, 8, 1924, p. 757.

(3) "*Use of Ethylene in the colouring of Citrus Fruits,*" E. M. Chace and F. E. Denny, *Industrial and Engineering Chemistry*, 16, No. 4, April, 1924, p. 339.

NEW CROPS FOR THE GOLD COAST.

MANY people outside the tropics remember the Gold Coast chiefly on account of its unenviable reputation as "The White Man's Grave," a title which it earned during the early days of the impingement of the European on the tropics. Those who are more familiar with recent developments in that Colony will not be unduly surprised at the news reported in "United Empire" (Vol. XV (New Series) No. 9, 1924) that this enterprising Colony intends to hold an exhibition of its own at Accra, the capital, in March and April of this year. The objects are (*a*) to promote trade and commerce and to give merchants and manufacturers an opportunity of making their goods more widely known among the people of West Africa, and (*b*) to bring together all those engaged in commerce, and the various industries represented at the Exhibition, for the exchange of ideas and the encouragement of local Arts and Crafts. The exhibition will comprise five principal sections, Commerce, Agriculture, Forestry, Minerals and Industry (including Arts and Crafts). The aims are highly commendable and quite in accordance with the spirit and energy of the country.

The growth of the cacao industry in the Gold Coast is perfectly amazing and probably unique in the sense that the production is carried on wholly by small peasant proprietors. In 1879 some seeds were brought from Fernando Po to the Gold Coast and by 1891 cacao was exported to the value of £4. In 1919 the exports of cacao were valued at 8 millions sterling and the Gold Coast had become the premier cacao producing region of the world, with a production of 195,000 tons, or nearly half the world's total. Another pleasing feature has been the slow but continuous improvement in the general quality of the cacao exported. This truly remarkable result has been achieved by peasant proprietors with the guidance and assistance of the Government. Thus far the situation is one for congratulation, but it should be clearly realised that any country which depends almost solely for its prosperity upon one particular crop is indeed in a precarious position. It may be that through disease, overproduction, or other causes, the industry, and with it the whole country, may be reduced to a low ebb. The destruction of the prosperous coffee industry in Ceylon by disease (Hemileia vastatrix) after 1876 is sufficiently recent, and of such importance, as to present a warning to other countries. The recent overproduction of plantation rubber is a warning of another type. Developments in the Gold Coast in common with most other countries, were seriously retarded by the Great War and by the slump which followed the unhealthy boom of 1919-20, but now there are pleasing indications of a revival in trade.

Every one hopes that no such disasters will overfake the cacao industry in the Gold Coast but it is satisfactory to note that the authorities are fully aware of the possibility, and are attempting to side track the danger by encouraging the production of other crops. Two interesting pamphlets have reached us recently, one by Mr. C. H. Knowles, B.Sc. (Lond.), Deputy Director of Agriculture, on the "Possibilities of Growing Cotton and other crops under irrigation in the Gold Coast" and the other by Mr. W. C. Fishlock on "The Establishment of Industries in Fresh Fruit in the Gold Coast." It is a widely known fact that from the beginning of the present century, European cotton manufacturers have been alive to the precarious position of their supplies of raw cotton. America is the chief producer of cotton for European markets but, while the world demand for cotton has been increasing the production of cotton in America has suffered a decline, and at the same time the internal demand for cotton in America is absorbing an increasingly large proportion of the home supply. The time may not be very far away when America will consume the whole of the cotton produced there, and consequently European countries are turning more and more towards potential producers of new supplies.

The production of cotton in the Gold Coast is of long standing and the raw cotton has been worked up into native cloths by primitive native appliances. Cotton has had to compete with the more popular and lucrative cacao growing industry and probably owing to this fact, the attempt at the beginning of this century to develop cotton growing as a native industry dependent upon natural rainfall ended in failure. The best average yield over an area of 203 acres was reported to be 422 lb. of seed cotton per acre, per annum. It is encouraging to note that cotton has been for some years a rain crop of some importance in the neighbouring region of Togoland.

The object of Mr. Knowles' pamphlet is to call attention to the possibilities of establishing cotton growing on a large scale under irrigation around the lower reaches of the Volta River, the region nearest to that of Togoland, where the industry is already established. A brief description of the geographical characteristics of the Volta River is given, and it is suggested that the cotton should be planted on the large stretches of undulating land between the point where the river cuts through the Akwapim Hills, and the coast. The area indicated by Mr. Knowles on the map accompanying the pamphlet, amounts to about 300,000 acres, of which a large area, probably in the neighbourhood of 150,000 acres might prove useful. It would appear that the rainfall at Akuse might be sufficient but unfortunately the rain falls chiefly in heavy showers, and much of it runs off and does not benefit the crops, while any individual month may be exceptionally dry. Hence cultivation would have to be carried on by means of irrigation. Rapids of considerable extent exist at Sendin, some few miles above Akuse, and a dam at a suitable place on the Volta might be made to serve the triple purpose of (*a*) irrigation (*b*) canalisation for up-river water transport and (*c*) generating electric power on a large scale.

Unfortunately no analyses of the soil are available for the area indicated and while these would be a necessary preliminary, it can be broadly

stated that the soil is of an alluvial nature of varying texture, light and open in many parts, but heavy in some areas as would be expected in the neighbourhood of a large river. The area suggested for irrigation comes within 25 miles of the coast and averages a distance of about 60 miles. The river is navigable for launches and lighters from its mouth to Akuse, while the mouth of the river at the Port of Addah is navigable for bar steamers, so that produce can easily be carried down the river from the proposed irrigated area to the ocean going steamers without risk of damage by surf. In the notes added by the Gold Coast Commercial Intelligence Department, Wembley, it is estimated that the total cost of transport from the Ginnery to Liverpool would amount to about £5 per ton, giving Gold Coast cotton an advantage of 1*d*. per lb. over cotton from Uganda or the Sudan, where the cost of transport is correspondingly dearer.

While the suggested area is not thickly populated there appears to be no shortage of labour, and it is well known that the West African is a good agriculturist, many in fact being employed in the Sudan. The scheme, while presenting a number of difficulties, is certainly worth careful consideration especially when the increase in the supply of cotton within the Empire is particularly desirable.

The activities of the Gold Coast authorities are not, however, confined to this one project comprehensive though it may be. Sugar-cane is another crop which it is suggested might with advantage be developed. The plant is already grown in many places in the Colony such as around the Kwatta Lagoon. At present the Gold Coast imports about 2,000 tons of sugar annually and it is suggested that the whole of this demand might be met by local supplies, and possibly an export trade begun with the neighbouring Colonies which have a larger total population, and correspondingly greater markets.

It should be emphasized that the Gold Coast particularly requires the introduction of crops which will find a ready market, and which can be grown by peasant cultivators with trained European advice, such as might be provided by an augumented Agricultural Department. Mr. Fishlock devotes his paper to a consideration of the fresh fruit crops which might profitably be developed. From his experience in the West Indies he believes that limes would form a peasant crop peculiarly suited to the habits of the Gold Coast natives. It has already been proved at the Assuantsi Agricultural Station that limes can be grown successfully, since high yields amounting to 300 barrels per acre have been secured over a series of years. Owing to the prevalence of disease and the recent hurricane, few limes are now produced in the original home of the industry, Montserrat, while the ravages of the "wither tip" disease in Dominica have prompted the suggestion by Mr. Fishlock that the centre of the lime industry might be transferred from the West Indies to West Africa. To do this a large measure of co-operation would be necessary between the peasant grower, the Government, and interested firms in Great Britain. In Dominica limes and cacao have been produced side by side, to some extent as peasant crops, and there seems to be no reason why a similar industry could not be established in the Gold Coast. It is a useful feature of the lime that it can be exported either as fresh fruit, raw or concentrated juice.

The introduction of cold storage on steamers during the 80's stimulated the export of bananas on a large scale from the tropics. The cultivation of bananas in Jamaica is a large and important industry and considerable quantities are exported both to the United States of America and the United Kingdom. The industry is to a large extent a peasant one, but unfortunately the plants have become seriously affected by disease, notably the Panama disease to which we referred in a recent number of this Journal (*Trop. Agr.* Vol. 1, No. 11, p. 172). Companies interested in the trade are said to be looking for new areas where the banana can be cultivated, and it is reported that an expert has been sent to the Cameroons to make an investigation and report. There are large areas in the Gold Coast suitable for the production of this fruit, and the natives have already had experience in cultivating the crop as it is often planted as a catch crop between growing cacao trees. Plantains are already grown over extensive areas, and where the plantain thrives there is no doubt that the banana will grow, as the conditions required are very similar, with the additional advantage that the banana is a less exacting crop and will thrive in less favourable circumstances. The banana is in increasing demand in temperate countries and is a fruit that stands handling and shipping well. While difficulties would at first be experienced in transporting and marketing the fruit, there is no doubt that these difficulties would soon be overcome with efficient co-operation between all interested parties.

Apparently no attempt has been made to cultivate pineapples on a commercial scale, although the plants thrive well in a semi-wild condition in many parts of the Colony. It seems reasonable to suppose that if the present plants were replaced by better varieties, a profitable industry might be established, especially in view of the fact that the plant requires very little cultivation. Pineapples thrive in sandy soil with a correspondingly low rainfall and would probably flourish in the belt of country, on the southern edge of the forest, which is unsuited to the successful cultivation of cacao, and which possesses the great advantage of being within 10-20 miles of the sea. Large parts of this land near the coast are already being planted with coconuts, and pineapples might be used as a catch crop between young coconut palms and, if planted thickly, might assist in keeping down weeds. The fruit stands a fair amount of handling and travels well, and while fresh fruit might be exported it is thought that canning might prove more profitable.

Orange trees grow and fruit freely in all the more fertile parts of the Colony but unfortunately the

young fruits are liable to attack by a fruit moth which causes immature shedding. Attempts to control this pest are being made, and provided these are successful another promising peasant industry might be established, with the advantage that the oranges would probably arrive in England when few others are on the market and so command a good price. Grape fruit requires conditions similar to that of the orange and since it is a fruit which is growing in popularity in the United Kingdom it might probably be grown side by side with the orange.

The avocado pear is a fruit as yet little known in Great Britain but a demand will doubtless arise as it becomes more familiar. The tree has been grown very successfully at the Assuantsi Agricultural Station which is situated in an area, about 12 miles from the sea, which is not ideal for cacao. Five years usually elapse between planting and the first cropping but after that period the trees bear for many years. Mangoes, which grow in all the more fertile parts of the Colony, are, like the avocado pear, little known in the United Kingdom but with the existing facilities in the shape of cold storage and rapid ocean transport they could easily be transported to England where, in a little while, they would probably find a ready market.

An export trade might similarly be established with the guava which has become thoroughly acclimatised in many parts of the Colony. Guava jelly forms a regular article of export from some of the West Indian Islands so that a market capable of extension already exists. Since it thrives in rather adverse circumstances the tree might be cultivated on a commercial scale and the fruit converted into jelly, preserved in syrup, or made into guava cheese, as found most desirable for export.

It will be noticed that in the main the conditions existing in the Gold Coast are suitable for the production of these crops and that large areas are already available for an extensive development without coming into direct competition with the needs of cacao. Most of the crops are suitable for cultivation by small peasant proprietors and possess the additional advantage of being already in considerable or increasing demand. Little difficulty would be experienced in transporting these products with the existing facilities, especially as the majority are capable of standing considerable handling. Whatever the result of the project may be, the desire to broaden the economic basis of the country's wealth is highly commendable, and it is to be hoped that it will meet with every success. The country is particularly in need of capital for the development of these industries, and the improvement of internal means of transport. The Exhibition at Accra, if it materialises, should greatly assist in solving the difficulties of the country and if it is successful in facilitating the introduction of new crops, will do much to prevent the Colony falling upon evil days by the failure or over-production of its staple crop, cacao.

C. Y. S.

VANILLA.

A Promising Minor Crop.

THE Agricultural Notes published by the Porto Rico Agricultural Experiment Station, July 15th, 1924 referred to the present status of the Porto Rican Vanilla. As this is a minor crop which might easily be more extensively developed, an abstract of these notes should be of interest.

The beginning of the present vanilla growing industry in Porto Rico dates from the introduction into that island of a few cuttings of *Vanilla planifolia*, of Mexican stock, the sort from which the finest beans are obtained.

As cuttings for propagation became available they were distributed and efforts made to stimulate interest, and it was thought that a commercial enterprise was under way. It was found, however, that only a few of the planters carried on the cultivation long enough to get results. One of these recently (1924) sold 1,375 lb. cured vanilla from an estimated area of 6 acres. The vanilla beans sold at $10.00 per lb.

The present high price cannot be expected to last. A few years ago vanilla sold for about $2.50 to $3.00 per lb. At this price, however, with a yield of 200 pounds per acre, more or less, the growing of vanilla might be a valuable minor industry, it is suited to the needs of the peasantry in many localities and might find a useful place in estate agriculture.

It has been found in Porto Rico that after a few crops have been obtained the vanilla vines succumb to a root disease. The vanilla is an orchid but unlike many other orchids it needs to keep in contact with the soil by means of its roots, and this root disease often proves fatal to the plant.

The prospect of several crops within a short time with the comparatively small cost of production makes vanilla seem a reasonably safe speculation, for it is a speculation like many another agricultural venture.

Vanilla comes into bearing in about four years from planting and as many as seven good crops have been obtained before production was interfered with by the root disease. Wherever this root disease occurs vanilla must be considered a temporary crop only.

In Porto Rico, vanilla is suggested as an intermediate rotation crop with coffee. Old and run out coffee with high shade may be converted into new plantations of low growing coffee with low shade; the same method would seem to be well adapted to the establishment of new coffee cultivation.

A suitable distance for planting coffee or vanilla is 8ft. × 8ft. or 6ft. or 7ft. × 9ft. The dwarf bucare (*Erythrina corallodendron*), may be used for supporting the vanilla and furnishing shade for the coffee. The bucare cuttings should be established and the vanilla cuttings placed on them. By the time the vanilla comes to blossom

young coffee trees should be interplanted. By the time the coffee came into bearing the root disease might be expected to appear and affect the vanilla. A young coffee plantation in this way should be established with little expense for cultivation, while the vanilla might be expected to yield a satisfactory profit.

The pollination of the flowers must be done by hand, and the curing of the pods requires a large amount of attention and care, but when this has been properly done the vanilla may be kept for some time in air tight containers lined with oiled or waxed paper. This makes it possible to hold the crop for better prices in the event of over-production and consequent low prices.

H. A. B.

"REVIEW."

"The Trade Commerce and Shipping of the Empire," by Sir Charles McLeod and Professor A. W. Kirkaldy, M.A., B.Litt. (Oxon.), London; W. Collins, Sons & Co., Ltd. Price 12s. 6*d*. net. pp. xxxvii+228 with three maps. Being No. VII in the Survey of the British Empire in twelve self contained volumes edited by Hugh Gunn.

The development of the tropics is, and will for very long remain, mainly an agricultural proposition; the wealth which is accruing and will in ever increasing amounts accrue, to tropical countries is dependent on the disposal of that produce in the markets of the temperate world where a dense population lives largely by industry and where, for reasons of climate, many of the essentials for food and the raw materials of industry cannot be raised. No apology therefore is required for drawing attention to a volume which deals with that most vital question of transport even though little is said about the actual bearing of the subject on tropical development.

Throughout all human activities an evolutionary process is observable; stage succeeds stage and a partial glimpse only is obtained if vision is circumscribed and limited to the activity of the moment. Again, no human activity is free from all dependence on collateral activities and independent progresss is an impossibility. In no line, perhaps, are these truths more patent than in the case of shipping. On one hand mechanical progress has gradually led to the development of the ship as we know it to-day where steam, and latterly oil, have replaced the wind as a motive power and where iron has replaced wood in construction; on another, scientific research has placed at the disposal of the investigator the Sextant, the Compass and the Chronometer without which scientific navigation could not have been evolved. Scientific research has, again, placed at the disposal of the shipper the cable and latterly wireless and thus reduced speculation, which was a necessary accompaniment of the earlier grade, till it "has become the mark of the parasite in business."

Take again the development of roads and canals which were effected throughout England in the latter half of the eighteenth century; it is a development which led to a more rapid interchange of goods and which, by facilitating the supply of raw material to be worked up under the cottage industrial system then prevalent, paved the way for the coming industrial revolution which, in turn, was rendered possible by the evolution of the steam engine and by the harnessing of the supplies of iron and coal. Henceforward England becomes an Industrial country supporting a population too large to be satisfied with home grown food supplies. The import of manufactured goods such as the cotton goods of the East is replaced by import of raw cotton to be worked up and sold in the markets which not long since supplied those very goods. Food and raw materials are bulky and the volume of imports largely exceeds exports. A means has to be found to supplement the volume of the latter to give that essential to cheap freight, full ships both out and in, and it is found in bunker coal, supplies of which along the trade routes become essential as steam replaces the sail as a means of propulsion.

Concurrently with these developments the opening up of foreign countries leads to a certain specialisation of products. Ships have no longer to feel their way along the coast but are enabled to steer a direct route to port. Consequently the evolution of trade routes becomes more and more marked, each characterised by certain peculiarities which are reflected in the type of ship. Violent changes have in the course of history taken place in these routes of which perhaps the most marked is the opening of the Suez Canal the capacity of which has placed so definite a limit on the size of ships trading to the East. More recently the opening of the Panama Canal has created such another change the consequences of which on the shipping of the world are not yet fully apparent. With the opening of the former a radical change had to be effected in the shipping and that England was first in the field is due to her financial credit. The clipper type, which owe their origin to the American challenge, and of which the Cutty Sark is the most famous, is doomed. The field is open to the first nation able to place a fleet of suitable ships on the seas and England alone carries a credit to effect this.

The opening up of a world trade raises yet other questions. Trade means barter and, without an acceptable medium of exchange, barter must be restricted. The numerous monetary systems with their different standards must restrict trade though such restriction may only become apparent when a sudden upheaval such as the recent war throws these exchanges into chaos. Again, the ideal for human happiness is the maximum of production for a minimum output of labour and this can only be achieved by a localisation of production which permits each article to be produced in the locality best adapted for such production. It is an ideal only obtainable with a fully mobile population and, for climatic reasons

alone, to disregard reasons of sentiment, such mobility is not practicable. World wide free trade is not attainable ; an unnatural distribution of production is, and will be, maintained and will have to be reckoned with.

At the present time we have a world crying aloud for commodities and even for necessities and yet we have a population crying aloud for employment. The solution has to be found. Undoubtedly the great deterrent to trade expansion at the present time is the instability of exchanges and until stability is introduced reconstruction cannot be rapid. At the present time no nation has such an outstanding position in the financial world that its currency is acceptable by all as a medium of exchange. The alternatives are given as the establishment of an international currency under the auspices of the League of Nations, a mutual understanding between England, France and the United States and the establishment of an Empire Bank backed by the credit of the Empire. The two former are for the moment outside practical politics ; the last alone remains. What England and the Bank of England did for the world in the last 150 years the Empire and an Empire Bank might do to-day.

Such is the general conclusion but in regarding the central harbour the outlying reefs must not be overlooked. Competition for the post of carriers of the world's trade is keen. America which fell out of the running with the American war, has re-entered the lists. Germany has already largely recovered her position and has added since the war some two and a half million to her tonnage which in efficiency is probably equivalent to her five million pre-war tonnage. In this position England no longer holds the financial pre-eminence and the Panama Canal has added doubt to the situation by disturbing the old shipping routes. Oil is largely replacing coal while America, India and South Africa now provide coal along the trade routes, thus materially altering the bunkering position. Our shipping interests have to avoid such reefs if the prosperity of the country and of the Empire is to be re-established.

It is a pity that such a theme has been marred by one or two features very minor though they be. Such, however, is the case where two different modes of expression are employed in a comparison. On page 82 the proportion of British to total shipping passing through the Canal is given in percentages except that the latest figures are quoted as ten and a half, out of seventeen, million tons. It is irritating to have to break the line of thought in order to do a sum in mental arithmetic. Again it is doubtful if the statement made in more than one place, that the English owe their position to the fact that the Englishman's word was his bond, adds to the value of the book. It is not a question of whether the fact is true or not, and after all it can only be relative for the English are only human and black sheep dwell in every fold ; it is that it is an *ex parte* statement the expression of which must throw doubt over the author's other statements and give an unnecessary handle for the would-be critic.

COLLEGE NEWS.

His Excellency the Governor, accompanied by Lady Byatt and Captain Traill visited the College. After tea with the Principal they visited the temporary buildings, the New College Building and the Sugar Factory over which they were conducted by Mr. G. Mayes, Engineer in Charge of the erection.

Mr. and Mrs. B. C. Forder of Dorset, visited the College on January 7.

Sir Francis Watts, K.C.M.G., D.Sc., *Principal Emeritus*, visited Dominica, at the request of the Colonial Office, in order to investigate the possibility of establishing new agricultural industries.

In a presidential lecture held under the auspices of the Lion's Club, a post-graduate organisation, the Principal gave an account of his tour through the Sudan with a description of the Mukwar Dam, the Gezira development scheme, the Nuba Mountains province and the White Nile area. The lecture was illustrated by lantern slides.

Mr. G. Mayes, Engineer in Charge of the construction of the College Sugar Factory, has left Trinidad to take up the post of Engineer in Charge of the Basseterre Sugar Factory, St. Kitts. The Factory will be completed under the direction of Mr. C. T. Watts, Technical Assistant.

Mr. R. Redver Follett-Smith, B.Sc. (Lond.) A.R.C.S., arrived at the College on January 5, by the *Oranje Nassau* to take a six month's course in Sugar Technology. Mr. Follett-Smith was educated at Skinner's School, Tunbridge Wells, and afterwards at the Royal College of Science, London.

Dr. C. L. Withycombe, accompanied by nine post-graduate students, Messrs. J. W. Cowland, B.A., J. B. Hutchinson, B.A., W. C. Lester Smith, B.A., H. Marsland, B.Sc. (Edin.), N.D.A., N.D.D. J. C. Muir, B.Sc., N.D.A., N.D.D., F. S. Parsons, B.S.A. (Guelph), J. E. Peat, B.Sc., (Edin.) F. A. Robb, B.Sc., N.D.A., I. A. Sutherland, and Mr. B. G. Montserin (3rd Year Diploma Student) paid a visit to St. Vincent from December 28th, 1924, until January 1st, 1925, for the purpose of studying the crops of that island, particularly cotton.

Expeditions were kindly arranged and conducted by Messrs. T. Jackson, Agricultural Superintendent and L. H. Burd, Cotton Research Assistant of St. Vincent and thanks to them much ground was covered in the short time available.

The College A.F.C. XI was defeated 1-0 by the Hotspur XI in the semi-final of the Clydesdale Cup.

The College re-opened on January 5.

The Editor still desires to re-purchase a limited number of Vol. 1 No. 9, (September, 1924) for which 2/- per copy will be paid. Readers having spare copies of these numbers are requested to communicate with the Editor at the Imperial College of Tropical Agriculture.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—The balance of the old crop supplies at Cuba is now practically exhausted.

COTTON.—With temporary fluctuations cotton has shown a steady inclination to slightly higher levels. This steadiness is somewhat significant in view of the number of " bearish " factors which have been ruling and indicates that any material decline in prices is unlikely.

COCOA.—West Indian and Ceylon cocoas have shown a general firmness, realising 17 cents per lb. New York, and 83*s.* to 86*s.* per cwt. London, both spot, but Accras favour buyers fetching 42*s.* 6*d.* per cwt. London on January 9th.

COFFEE :—All grades of coffee are again dearer, Costa Rica rising to 172*s.* per cwt. on December 17th, Mysore middling to 164*s.* Kenya, good middling to 160*s.* and Brazil Santos after rising to 124*s.* on December 10th, declined to 122*s.* on December 17th. The figures appear to indicate a steady progressive demand in the United Kingdom.

TEA.—After November 13th general prices for tea rose rapidly until December 3rd, when Ceylon averaged 25·25*d.* per lb. India 24*d.* and Java 21*d.* Since the latter date teas have in general suffered a decline, the average price per lb. realised on December 17th being, Ceylon 23·85*d.* India 22·47*d.* Java 19·48*d.* Figures for the export of China tea during 1923 have recently become available and show that 106,856,100 lb. of all grades were exported, Great Britain receiving a little more than 23,000,000 lb. The trade with Russia, once a very important market, has declined to 1,620,000 lb.

SISAL AND HEMP.—Hemp has declined in price, standard Philippine hemp agave Manila J. realising £54 per ton. Excellent East African Empire sisal is available at £49 per ton.

RUBBER.—After a temporary decline rubber has again risen, reaching 18½*d.* per lb. spot (Lond.) on January 9, for good plantation crepe. The average price of rubber in London, November 1, to December 13, was 17*s.* 6*d.* on all sales.

RICE.—Rice is somewhat easier and favours buyers of large quantities, prices declining to 18*s.* 6*d.* per cwt. on December 17 for Burmese, but spot prices for small lots have shown little alteration since November.

COPRA. — Copra declined generally from November 12, to December 3, when Ceylon reached £31 10*s.* per ton and sun dried Straits to Rotterdam £29 per ton. Since then there has been a general revival, Ceylon realising £32 5*s.* Dutch East Indies £30 10*s.* and Federated Malay States £30 17*s.* 6*d.* per ton on December 17.

OILCAKE.—After a slight rise subsequent to November 17, Linseed oilcake again closed at 13*s.* 9d. per cwt. Cotton seed oilcake rose to 9*s.* but afterwards fell to 8*s.* 2*d.* per cwt. on December 17. Coconut oilcake fell from 12*s.* 7½*d.* per cwt. on November 12th to 11*s.* 2*d.* on December, 17th.

SUGAR STATISTICS.

MESSRS. LAMBORN & CO., estimate that the 1924-25 Cuban sugar crop will amount to 4,500,000 long tons, representing an increase of 438,000 long tons, or 12 per cent. over the record production of 4,062,248 long tons during the 1923-24 season. The world's total yield of cane and beet sugar is expected to amount to 22,700,000 long tons, or 2,400,000 long tons more than in the previous record year of 1923-24.

In reviewing the figures for the last 25 years it is interesting to note that in 1900-01 and 1901-2 the production of beet sugar exceeded the production of cane sugar, but in every subsequent year, with the exception of 1095-6, the production of cane exceeded that of beet. Up to the outbreak of war the total production of sugar had been increasing, with minor seasonal fluctuations, rising from 11,900,000 long tons in 1900-01 to 18,400,000 long tons in 1913-14. The commencement of hostilities, however, brought about a collapse of the beet sugar industry on the Continent and the output fell from 8,500,000 long tons in 1913-14 to approximately 3,000,000 long tons in 1919-20. Since the termination of the war beet has been steadily recovering, and this year the production is expected to reach 7,760,000 long tons, a figure surpassed only three times in the last 25 years. On account of the collapse of the beet industry the cane industry was stimulated and production rose rapidly during the war period from about 10 million long tons to 13 million long tons in 1917-18.

The spot market for sugar continues strong showing a slight advance and with no immediate prospect of falling until the bulk of the new Cuban crop comes on the market. The strength of the spot market, combined with the fact that sugar producing countries will probably grind the largest crop on record, has encouraged earlier grinding in spite of the unfavourable weather and unsettled labour conditions. The first mill in Cuba commenced operations on November 29, whereas in the previous year none began before December 8.

Buyers are expected to pursue a hand-to-mouth policy, allowing reserve stocks to decrease to a low level, anticipating that when sufficient of the new crop becomes available, prices will rule lower than those at present obtaining for spot, and no difficulty is expected in securing adequate supplies.